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SNAP 10A Prelaunch Operations
NPU Prelaunch Operations-SPTF

AUTHOR

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NAA-SR-MEMO-9352
REVISION A

TECHNICAL MANUAL

SNAP 10A
PRELAUNCH OPERATIONS

NPU PRELAUNCH OPERATIONS-SPTF

ATOMICS INTERNATIONAL

PUBLISHED UNDER AUTHORITY OF
THE ATOMIC ENERGY COMMISSION
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CONTENTS

	Page
Introduction	x
I. NPU Prelaunch Operations Program	1-1
1-1. General	1-1
1-3. Scope and Purpose	1-1
1-5. Receiving Inspection	1-1
1-6. Quality Assurance Testing	1-1
1-7. NPU System Reassembly	1-1
1-8. Packaging	1-2
1-9. Modification and Repair Capability	1-2
II. NPU System Description	2-1
2-1. General	2-1
2-3. NPU System Configuration	2-1
2-6. Theory of Operation	2-4
2-10. Major Components	2-4
2-12. SNAP 10A Reactor	2-4
2-19. Radiation Shield Assembly	2-6
2-20. Reflector Control Assembly	2-6
2-25. Power Conversion Assembly	2-6
2-27. Structural Shell	2-7
2-28. Ejectable Heat Shield	2-7
2-29. Heat Barrier	2-8
2-30. NaK Heat Transfer System	2-8
2-32. Expansion Compensators	2-8
2-33. System Wiring Harnesses	2-8
III. Data Requirements	3-1
3-1. General	3-1
3-3. NPU Verification Log	3-1
3-5. Responsibility	3-1
3-6. Procedure for Logbook Entries	3-1
3-8. Addendum Page	3-3
3-9. Data Sheets	3-3

CONTENTS

	Page
3-10. Data Report	3-3
3-12. Procedure/Design Change Notice (P/DCN)	3-3
3-15. Supplementing Documents	3-5
IV. Quality Assurance Testing	4-1
4-1. General	4-1
4-3. Responsibility	4-1
4-4. Prelaunch Testing Operations	4-1
4-5. Quality Control	4-1
4-6. Industrial Health and Safety	4-1
4-7. Documentation	4-1
4-9. Receiving Inspection	4-3
4-11. Purpose	4-3
4-12. Scope of the Receiving Inspection	4-3
4-14. Equipment Requirements	4-3
4-15. Trip Log Evaluation	4-4
4-16. Unpackaging Procedure	4-4
4-18. NPU Unpackaging Procedure	4-4
4-19. Reflector Assembly Unpackaging	4-6
4-20. Heat Shield Unpackaging Procedure	4-7
4-21. NPU System Inspection Procedures	4-8
4-22. Purpose and Scope	4-8
4-23. NPU System Status	4-8
4-24. Visual Inspection	4-8
4-25. NaK System Inspection	4-11
4-29. Reflector Inspection and Preparation	4-11
4-30. Purpose and Scope	4-11
4-31. Reflector Assembly Status	4-12
4-32. Reflector Checkout and Make-Ready Procedure	4-12
4-46. Electrical Reference Checks	4-18
4-47. Purpose	4-18
4-48. Scope	4-18
4-49. NPU Status	4-18
4-50. Equipment Required	4-18
4-51. Preparation	4-19

CONTENTS

	Page
4-52. Power Converter Continuity and Module Resistance Check . .	4-19
4-53. Purpose and Scope	4-19
4-54. Equipment Requirements	4-19
4-55. Power Converter Continuity Check	4-19
4-56. Power Converter Resistance Check	4-20
4-57. Converter Insulation Check	4-20
4-58. Relay Status Check	4-22
4-59. Purpose and Scope	4-22
4-60. Equipment Requirements	4-22
4-61. Procedure	4-22
4-62. NPU Insulation Resistance Check	4-23
4-63. Purpose and Scope	4-23
4-64. Equipment Requirements	4-23
4-65. Procedure	4-23
4-66. Circuit Isolation Resistance Check	4-23
4-67. Purpose and Scope	4-23
4-68. Equipment Requirements	4-24
4-69. Procedure	4-24
4-70. Circuit Loop Resistance Check	4-24
4-71. Purpose and Scope	4-24
4-72. Equipment Requirements	4-24
4-73. Procedure	4-24
4-77. Electrical System Functional Checks	4-26
4-79. Purpose	4-27
4-80. NPU Status	4-27
4-81. Prerequisites	4-27
4-82. Equipment Requirements	4-27
4-83. TSM-2A Preparation	4-27
4-85. Reflector Preparation	4-28
4-86. Electrical System Functional Check Procedures	4-28
V. NPU System Reassembly	5-1
5-1. General	5-1
5-3. Reassembly Operations	5-1
5-4. NPU System Status	5-1

CONTENTS

	Page
5-5. Reflector Assembly Installation Procedures	5-1
5-6. Purpose and Scope	5-1
5-7. Equipment Requirements	5-1
5-8. Reworking Reflector Assembly Pin Pullers	5-3
5-9. Reflector Assembly Preparation	5-4
5-22. Reflector Assembly Installation	5-7
5-33. TABRD Inspection	5-15
5-34. Reflector Installation Clearance Check	5-16
5-35. Agena Mating Ring Installation Procedure	5-16
5-37. Equipment Requirements	5-17
5-38. Installation Procedure	5-17
5-39. Ejectable Heat Shield Installation Procedure	5-19
5-40. Purpose	5-19
5-41. Equipment Requirements	5-19
5-42. Installation Procedure	5-19
5-43. Heat Shield Removal Procedure	5-21
VI. NPU Delivery Preparations, Phase I	6-1
6-1. General	6-1
6-3. Scope	6-1
6-4. NPU Status	6-1
6-5. Equipment Requirements	6-1
6-6. Prepackaging Verification Checks	6-1
6-8. Relay Status Check	6-1
6-9. Converter Continuity and Resistance Checks	6-1
6-10. NPU Physical Inspection	6-2
6-11. NPU Packaging Procedure	6-2
6-13. NPU Shipping Container Preparation	6-2
6-14. NPU Packaging	6-2
6-15. Heat Shield Packaging	6-2
6-16. Shipment	6-2

CONTENTS

	Page
VII. Repair Limits	7-1
7-1. General	7-1
7-3. Scope of Operations	7-1
7-4. Repair and/or Damage Assessment	7-1
7-7. Definition of Repairs	7-2
7-9. Repair Procedures	7-2
7-11. Radiation Shield Removal and Installation	7-2
7-13. Prerequisites	7-2
7-14. Preparation	7-2
7-16. Radiation Shield Removal	7-3
7-19. Radiation Shield Installation	7-4
7-23. Reflector Assembly Removal	7-6
7-25. NPU Status	7-6
7-26. Equipment Requirements	7-6
7-27. Precautions	7-6
7-28. Preparation for Reflector Removal	7-7
7-29. Sleeve Installation and Reflector Removal	7-8
7-30. Center of Gravity Determination	7-10
7-32. CG Determination Procedure	7-10
7-33. NaK Downloading	7-10
7-35. Draining Procedure	7-10
7-36. Thermal Emittance Measurements	7-12
7-37. General	7-12
7-38. Equipment Required	7-12
7-39. Environmental Conditions	7-12
7-40. Safety Precautions	7-12
7-41. Emissometer Preparation Procedure	7-12
7-42. Calibration	7-14
7-43. Measurement Procedure	7-15
7-45. Solar Absorptance Measurements	7-18
7-46. General	7-18
7-47. Equipment Required	7-18
7-49. Environmental Conditions	7-18
7-50. Safety Precautions	7-18

CONTENTS

	Page
7-51 Preparation Requirements	7-18
7-53. Calibration	7-20
7-54. Measurement Procedure	7-20
VIII. Interim Operations	8-1
8-1. General	8-1
8-3. Scope and Purpose	8-1
8-4. Scheduling	8-1
8-5. NPU Unpackaging	8-1
8-6. Heat Shield Unpackaging	8-1
8-7. NPU Power Converter Resistance and Continuity Checks	8-2
8-8. Thermal Emittance Measurements	8-2
8-9 Reflector Assembly Inspection	8-2
8-10. Purpose and Scope	8-2
8-11. NPU Status	8-2
8-12. Vessel-Reflector Clearance Check	8-2
8-14. Unpowered Relay Status Check	8-3
8-15. Electrical System Functional Checks	8-3
8-16. NPU Prepackaging Inspection	8-3
8-17. Purpose and Scope	8-3
8-18. NPU Visual Inspection	8-3
8-19. Reflector Assembly Inspection	8-4
8-20. NPU Packaging	8-5
IX. NPU Prelaunch Operations - Support Parts	9-1
9-1. General	9-1
9-4. Illustrated Parts Breakdown	9-2
ADDENDUM A. Full Current Squib Fire Test	A-1

LIST OF ILLUSTRATIONS

	Page
1-1. Flow Diagram of NPU Prelaunch Operations Performed at the SPTF.	x
2-1. SNAP 10A System Configuration	2-3
2-2. Reflector Control Assembly	2-7
3-1. Sample of NPU Verification Log Page	3-2
3-2. Data Sheet Used for Prelaunch Operations	3-4
4-1. Flow Sequence Diagram SPTF Quality Assurance Testing Activities	4-2
4-2. Inspection Area Identification for NPU Base Section	4-9
4-3. NPU Configuration Check List	4-10
5-1. NPU System Reassembly Sequence - SPTF	5-2
5-2. Lockwire Installation	5-3
7-1. Measurement Points for Thermal Emittance and Solar Absorptance Measurements	5-16
7-2. Data Sheet Used for Recording Heat Shield Coating Data	7-17

LIST OF TABLES

2-1. SNAP 10A Nominal System Parameters	2-2
4-1. Electrical System Functional Check Procedures	4-29
9-1. Illustrated Parts Reference	9-4

NAA-SR-MEMO-9352

INTRODUCTION

The purpose of this manual is to provide information and procedures associated with the SNAP 10A prelaunch operations conducted at the SNAP Prelaunch Test Facility (SPTF), building 6527, located at Vandenberg Air Force Base (VAFB).

Activities included in SPTF prelaunch operations are illustrated in the frontspiece flow diagram. These begin upon receipt of the SNAP 10A system at the SPTF and conclude with shipment of the assembled SNAP 10A nuclear power unit (NPU) to the Point Arguello Launch Complex No. 2 (PALC-2). Each phase of the SPTF prelaunch operations program is concerned with preparing the NPU for launch.

Potential hazards encountered in SPTF prelaunch operations are presented in NAA-SR-MEMO-8685, SNAP Prelaunch Test Facility Safeguards Report. In this report it is concluded that the maximum credible accident which could occur would be a liquid metal (sodium-potassium) fire. The possibility of such a fire is improbable as prelaunch operations do not require opening the sealed liquid metal system. No nuclear tests are conducted during prelaunch operations as these are performed during final acceptance testing at Atomics International's Santa Susana facility.

Safety rules and procedures applicable to SPTF prelaunch operations are presented in NAA-SR-MEMO-9353, SPTF Operations. Procedures relating to handling and shipping of the NPU are presented in NAA-SR-MEMO-9351, SNAP 10A Shipping Procedures.

Figure 1-1. Flow Diagram of NPU Prelaunch Operations Performed at The SPTF

SECTION I

NPU PRELAUNCH OPERATIONS PROGRAM

1-1. GENERAL.

1-2. The objective of the prelaunch operations program conducted at the SPTF is to prepare and verify flight readiness condition of the SNAP 10A system for delivery to PALC-2.

1-3. SCOPE AND PURPOSE.

1-4. Program scope includes a receiving inspection of the NPU system to ascertain possible damage incurred during transit from Santa Susana to the SPTF. This is followed by detailed electrical and mechanical inspection and testing. The system is subsequently reassembled and tested in preparation for delivery to PALC-2. The purpose of these activities is to verify flight readiness status of the NPU, both electrically and mechanically.

1-5. RECEIVING INSPECTION. Trip logs and shipping records are evaluated following arrival of the NPU system at the SPTF. The system is subsequently off-loaded and unpackaged if no anomalies are evident. System components are mounted on applicable fixtures and given a rigid visual inspection to ensure system integrity.

1-6. QUALITY ASSURANCE TESTING. This testing phase is performed to ensure electrical and operational integrity of the SNAP 10A system prior to reassembly. It embodies detailed electrical tests to ensure that electrical system resistance, impedance and relay status are within established parameters. Thermal emission and absorptance tests are also conducted. NPU system components are then coupled electrically and functional checks are performed to verify operation of the system. Verification of test results is provided by entries in the NPU Verification Log (Section III, paragraph 4-3).

1-7. NPU SYSTEM REASSEMBLY. The NPU system is received at the SPTF packaged in three individual shipping containers. These major components are subsequently assembled following completion of quality assurance tests. Assembly operations include installation of the reflector assembly on the NPU reactor, mounting the Agena mating ring, and mounting the ejectable heat shields to verify the installation fit.

1-8. PACKAGING. The ejectable heat shields are removed and packaged in the heat shield shipping container upon completion of the fit check. The NPU Handling Fixture is then installed on the NPU. The assembly is encased in a plastic envelope and placed in the NPU Shipping Container in preparation for delivery to PALC-2.

1-9. MODIFICATION AND REPAIR CAPABILITY.

1-10. The extent of NPU modification or repair cannot be forecast. Minor repair facilities are available at the SPTF in addition to the capability for performance of the following operations:

- a. Center of gravity determination.
- b. Removal and reinstallation of the radiation shield.
- c. NaK downloading.

Although these operations are not an anticipated part of the prelaunch operations program, related procedures are included in Section VIII of this manual.

SECTION II

NPU SYSTEM DESCRIPTION

2-1. GENERAL.

2-2. The SNAP 10A nuclear power unit (NPU) consists of a compact nuclear reactor operating in conjunction with a thermoelectric power conversion unit. The NPU is capable of delivering 500 watts of continuous power to the payload of an orbiting space vehicle for at least one year. After startup in orbit, on ground command, the NPU operates without need for active control. Nominal system parameters are presented in Table 2-1.

2-3. NPU SYSTEM CONFIGURATION. The reactor and power conversion system are received at the SPTF as an integral unit. Shipment in this configuration is necessary as the two assemblies share a common coolant system which is filled with eutectic sodium-potassium (NaK) alloy. Major components of the SNAP 10A system are as follows:

- a. Reactor.
- b. Reactor reflector assembly.
- c. Power conversion assembly.
- d. Radiation shield assembly.
- e. Ejectable heat shield assembly.

2-4. To assure maximum nuclear safety during shipment of the NPU system from Santa Susana to Vandenberg Air Force Base, the reactor reflector assembly is removed from the reactor and shipped in a separate container. To further assure nuclear safety, a non-reflective shipping sleeve is installed on the reactor to prevent criticality even if the reactor is immersed or flooded in hydrogenous fluids such as water.

2-5. The assembled NPU system is a truncated cone having a base diameter of approximately 5 feet and an overall height of approximately 10 feet. System configuration is illustrated in Figure 2-1.

System	Nominal System Parameters
Design Life (minimum)	1 year
Reactor type	U-Zr Hx thermal, NaK cooled
Power	0.525 kwe
Reactor power	39.5 kwt
Reactor outlet temperature	987°F
Reactor inlet temperature	859°F
Core volume	0.3 ft ³
Power Conversion System	Thermoelectric
Power conversion	Ge-Si modules
Output voltage (minimum)	28.5 vdc
Heat transfer medium	Eutectic sodium-potassium (NaK)
Avg. Hot junction temperature	920°F
Avg. Radiator temperature	601°F
Radiator area (ft ²)	62.5 ft ²
Ft ² /kwe	120
System Weight	970 lb
Lb/kwe	1850
Payload Dose	
Neutron (nvt)	10 ¹²
Gamma (Rad)	10 ⁷
System Dimensions	
Length overall	137 inches
Top diameter (converter section)	23 - 25 inches
Mounting base diameter	50 inches
Reactor core vessel diameter	9 inches
Reactor core vessel height	15.6 inches
Reflector control drum thickness	2 inches

Table 2-1. SNAP 10A Nominal System Parameters

Figure 2-1. SNAP 10A System Configuration

2-6. THEORY OF OPERATION.

2-7. The NPU utilizes a uranium fueled nuclear reactor heat source which uses circulating liquid metal sodium-potassium alloy (NaK) as a heat transfer medium. Heat is transferred via the NaK, to a thermoelectric power conversion unit which produces electricity without the need for moving parts. Electricity is generated in the power conversion unit by maintaining a temperature differential between opposite faces of thermoelectric elements.

2-8. Temperature differential is provided by circulating the hot NaK along the face of the thermoelectric conversion units (hot side) while the opposite face (cold side) is cooled by aluminum radiator fins which radiate heat to space. Circulation of the NaK alloy through the thermoelectric converter and reactor core is maintained by means of a direct current Faraday thermoelectric conduction pump. This pump derives its power from a shorted thermocouple which makes use of the temperature differential existing between the NaK alloy exiting from the reactor and a cold junction provided by a small radiator. A permanent magnet supplies the magnetic field for the pump.

2-9. Reactor control is effected by a beryllium reflector and control drum assembly. Motor actuated control drums are rotated to increase the reactivity of the reactor and thus control the heat output. In the launch configuration, the four control drum elements are held in the OUT position by squib-released locking pins. The squibs are fired by ground command when the system achieves orbit. When pins are released, two of the control drums are snapped into full IN position by spring action. The other two control drums simultaneously begin stepping in at the rate of 0.5 degrees per 150 seconds. When the reactor reaches operating temperature, insertion of the drums is stopped and the startup temperature controller assumes control. This device causes actuation of the control drums to maintain a constant temperature level during the transient startup period of approximately three days. Subsequent long term control is effected by the inherent temperature coefficients of reactivity and fuel burnup.

2-10. MAJOR COMPONENTS.

2-11. The mechanical configuration of the major components are described briefly in the following paragraphs. Detailed parts lists and illustrations are presented in Section IX of this manual.

2-12. SNAP 10A REACTOR. The reactor core is contained in a cylindrical vessel approximately 9 inches in diameter by 16 inches in height, constructed of

stainless steel. The vessel contains upper and lower plenum chambers which, together with drilled grid plates, provide proper flow distribution of the NaK coolant through the reactor core. Fuel in the reactor vessel is sealed within 37 Hastelloy tubes, supported and positioned by grid plates in the bottom and top of the reactor vessel. The reactor is fueled with enriched U-235 and is zirconium-hydride moderated. Beryllium is used as the reflector material to control reactivity.

2-13. Mechanical Protective Devices.

2-14. Mechanical devices are incorporated during all handling operations prior to actual launch, to prevent the reactor from going critical. These devices include the shipping sleeve, void filler blocks, keyed drum locking arms and squib operated locking pins.

2-15. Shipping Sleeve. This consists of a two-piece sleeve installed around the core vessel during shipment from SS to VAFB. The sleeve minimizes neutron reflection from outside reflecting media. Constructed of stainless steel, the sleeve is divided into a number of boron-filled and void cells which serve to minimize reflectivity.

2-16. Void Filler Blocks. These are special blocks which are bolted to the reflector main block at all times when the reflector is installed on the reactor. The filler blocks fill the voids left by the control drums when the drums are in OUT position, and thus prevent the drums from rotating inward to a critical or startup position.

2-17. Keyed Drum Locking Arms. Each control drum is locked in the OUT position by key operated locking arms which attach to the reflector main block. The locking action is achieved by insertion of a stop (arm) in a slot in the control drum, which prevents drum rotation. A spring latch prevents removal of the drum locking arms from the snap-in drums unless the locking pins are in place. Four different keys, one for each lock, are used for the drum locking arms. Keys are under control of the Test Conductor, who will unlock the control drums just prior to launch.

2-18. Squib Operated Locking Pins. Squib actuated locking pins are used to retain the control drums, expansion compensators, and heat shield halves in prelaunch position during NPU countdown and launch. The pyrotechnic squibs are held in a pin puller which provides locking action until the squib is fired. Each pin puller contains two squibs, the second providing backup redundancy. Actual firing of the

squibs will not take place unless and until the NPU/Agena space vehicle achieves satisfactory orbit. Dummy squibs are used for all phases of prelaunch testing. No pyrotechnic squibs are installed until launch operations are initiated.

2-19. RADIATION SHIELD ASSEMBLY. A stainless steel lithium-hydride filled shield mounts below the reactor assembly to minimize exposure of the payload instrumentation to radiation during orbital operation. The shield serves as a shadow shield rather than encasing the entire reactor assembly.

2-20. REFLECTOR CONTROL ASSEMBLY. The assembly as illustrated in Figure 2-2 is a separate unit which can be installed or removed without disrupting the reactor or coolant piping. Components making up the reflector assembly include the reflector main block, control drum assemblies, reflector shims, ejection mechanisms, drum locking devices and support bracketing.

2-21. Fixed Reflector Main Block.

2-22. A beryllium cylinder approximately 2 inches thick with the same height as the fuel elements forms the reflector main block. The cylinder is split longitudinally to form two separate halves which are independently mounted. Each section contains two control drums.

2-23. Control Drums.

2-24. Spaced at 90 degree intervals around the reflector main block are four solid beryllium control drums which serve to control reactivity of the reactor. The drums rotate on bearings and fit into pockets machined in the main block. The drums are held full out until reactor startup and operation is initiated. Upon reactor startup, two of the drums located 180 degrees apart provide coarse control as they are driven inward by snap-in spring action. The other two drums are rotated by individual actuator motors to provide incremental control or fine adjustment. Movement of these drums is at the rate of 0.5 degrees per 150 seconds.

2-25. POWER CONVERSION ASSEMBLY.

2-26. This assembly is in the shape of a conical frustum which consists of an array of 40 D shaped stainless steel coolant tubes mounted on a supporting structure. Seventy-two thermoelectric converter elements mount on the coolant tubes; each tube is connected to the NaK inlet and outlet manifolds. The assembly is approximately 7 feet high with end diameters of 2 and 4 feet, mounting a total of 2880 thermoelectric elements. Total area of the radiator converter is 62.5 square feet.

8-26-63

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Figure 2-2. Reflector Control Assembly.

2-27. **STRUCTURAL SHELL.** Eight separately formed pieces, welded together to form a truncated cone, provide the basic radiator-power converter shell structure. Forty rectangular convolutions extend the full height of the shell and are equally spaced about the shell surface to provide channels for longitudinal support of the 40 NaK tubes. Five ring stiffeners riveted about the inside cone circumference provide structural rigidity. The shell structure collects loads imposed by the main components mounted at the top, transmitting the loads to the lower support base ring, and hence to the Agena vehicle.

2-28. **EJECTABLE HEAT SHIELD.** To prevent NaK freezeup during launch and initial orbit, a heat shield consisting of two halves, split lengthwise, is used to cover the radiator-power converter. The shield is constructed of aluminum with a

honeycomb core, the sandwich material being approximately 1/4 inch in thickness. Upon installation, each shield half is held in place by squib-fired pins which permit the shield to be ejected by thermal switch command once orbit is achieved. Heat control is achieved by special emissive and absorptive aluminum silicon paint applied in 3-inch vertical stripes to the outer surface of the shield. Shield weight is approximately 32 pounds .

2-29. HEAT BARRIER. A blanket of heat resistant material (aluminum foil and glass fiber) is bonded across the bottom of the power converter support structure above the instrument compartment to form a heat barrier. This barrier impedes heat flow from the NPU to the Agena vehicle and provides a low temperature environment for the instrument compartment. A compartment beneath the heat barrier, at the base of the radiator-power converter, is provided for system control and instrumentation components.

2-30. NaK HEAT TRANSFER SYSTEM.

2-31. The NaK heat transfer system is comprised of a NaK pump, expansion compensator units, plumbing and the eutectic sodium-potassium alloy coolant. These items comprise a closed loop system in which the NaK is circulated by the thermoelectric pump. Two expansion compensators assure a void-free system.

2-32. EXPANSION COMPENSATORS. The two bellows type expansion compensators are mounted in the lower portion of the power conversion units. These units compensate for volume changes, due to temperature differences, in the NaK coolant and serve to regulate coolant system pressure. The compensators are maintained in a closed position until orbit is achieved. Upon command signal, the pyrotechnic squibs are fired, releasing the pins holding the compensators in the closed position.

2-33. SYSTEM WIRING HARNESSES.

2-34. SNAP 10A wiring harnesses are comprised of the high temperature wiring, instrument compartment wiring, and power conversion or structural shell wiring. Harness cables are insulated with fiberglass insulation and encased in stainless steel shielding. High temperature terminal lugs and connectors are provided on wiring harness subjected to high temperatures.

SECTION III

DATA REQUIREMENTS

3-1. GENERAL.

3-2. Scheduled NPU prelaunch operations conducted at the SPTF are documented in the NPU Verification Log. Unscheduled operations and/or repairs are recorded on forms provided to support the NPU Verification Log. These support documents are the Data Report and Procedure/Design Change Notice.

3-3. NPU VERIFICATION LOG.

3-4. All action taken to prepare the SNAP 10A system for flight readiness is recorded in the verification log. This includes data taken during reference and operational checks in addition to completion of routine procedural steps and other nonroutine operations that may be required. Documents pertinent to log entries are inserted in the appendix of the log.

NOTE

The pertinent section of the NPU Verification Log shall always accompany the NPU and be readily available at the site of operations.

3-5. RESPONSIBILITY. The Test Conductor, or his designated alternate, is responsible for the maintenance and safekeeping of the logbook. He shall make certain that each sequential step listed in the logbook is completed and signed off, or if not completed, is explained in the REMARKS SECTION.

3-6. PROCEDURE FOR LOGBOOK ENTRIES. Instructions for completing the entries on the individual log page are included on the sample page shown in figure 3-1. Each step must be initialed by both the operator and QC representative, or noted under REMARKS, before proceeding to the next step. Signature blocks at the bottom of the page must be filled in upon completing the page, or in the event the checklist is continued on the following page, upon completion of that portion of the test.

3-7. Deviation from allowable limits, tolerances, or established conditions are explained in the REMARKS section of the individual page. Support documents such as the Procedure/Design Change form, Data Report, Engineering Order are

SNAPSHOT PRELAUNCH VERIFICATION						Page ____ of ____		
(2) Prelaunch Operation: _____ Reference Document: SPTF-NPU Prelaunch Operations Manual, Section V.		(1) RECEIVING INSPECTION		(3) Site: SPTF				
Procedural Steps: Re: Par. 5-5 (4) 5-6. Trip log evaluation: (5) <ul style="list-style-type: none"> a. Violent starts b. Violent stops c. Violent jolts d. Excess radiation e. Abnormal pressure variation f. Temperature extremes g. NaK leak h. Excess humidity i. Recorder operation (6)		Value		Date	Time		Operators	
		Recorded	Allow.		Start	Stop	Tech.	Insp.
		(7)	(8)	(9)	(10)	(11)		
Remarks: (12) <div style="text-align: center;">KEY</div> (1) Title from applicable NPU prelaunch operations manual. (2) Name of reference document and applicable section. (3) Site at which operation is performed. (4) Paragraph reference from reference document. (5) Title of procedural step given in reference document. (6) Checklist steps in detail. (7) Enter recorded value if measurement, etc. is taken. (8) Allowable or expected value of measurement. (9) Enter date the operation is performed. (10) Enter stop and start time for the task. (11) Technician or engineer performing operation, and QC representative initials as each step is completed and checked. (12) Enter applicable remarks or explanation. (13) Check applicable block if any listed operation was performed in accordance with a supporting document. (14) Final sign-off after all listed operations are completed.		<div style="text-align: center;">Associated Documentation</div> ☐ - P/DC No. _____ ☐ - E.O. No. _____ ☐ - 23H No. _____ ☐ - D.R. No. _____ ☐ - Other _____						
		<div style="display: flex; justify-content: space-between;"> <div> (14) → <div style="border-left: 1px solid black; padding-left: 10px;"> Technician _____ Date _____ Inspector _____ Date _____ Test Conductor _____ Date _____ </div> </div> </div>						

Figure 3-1. Sample of NPU Verification Log Page

referenced in the space provided on the page. A copy of the applicable support document is inserted in the appendix of the verification log.

3-8. ADDENDUM PAGE. An addendum page may be used if additional space is required to complete the remarks relating to a logbook page. The addendum page is inserted in the NPU Verification Log, following the page to which it applies.

3-9. DATA SHEETS. The data sheet is also used as an addendum to the NPU Verification Log in cases where extensive data is collected as the result of a detailed checkout procedure. Information called for on the data sheet is included in the related procedure appearing in this manual. A sample data sheet is shown in Figure 3-2.

3-10. DATA REPORT.

3-11. Initiation of the Data Report (see Section IV, NAA-SR-MEMO-9353) is at the discretion of the Test Conductor. It is intended that the form be used to report test completions, malfunctions, and replacements or repairs as related to the NPU or prelaunch operations. The discretionary part of initiating the report is based upon the judgment of the Test Conductor and Engineering Supervisor whether a given out-of-tolerance condition is a malfunction or an operational error.

3-12. PROCEDURE/DESIGN CHANGE NOTICE (P/DCN).

3-13. This document is used to authorize a change to the approved NPU prelaunch operations procedures and Health and Safety procedures. It is the only document used during NPU prelaunch operations which serves as authorization for such change. The P/DCN serves to supplement the NPU Verification Log in that it provides documentation of the following:

- a. A verbal instruction from the Test Conductor regarding alteration of a procedure, repair, removal or replacement of a component.
- b. A verbal instruction from the SNAP 10A Section AI Program Director regarding the above condition and/or Health and Safety procedures.
- c. Instruction, either verbal or written, relating to modification of ground support equipment (AGE) or handling procedures.

3-14. Instructions for use and completion of the P/DCN form, including a sample page, are given in Section IV of the NAA-SR-MEMO-9353.

NPU VERIFICATION LOG DATA SHEET NO. _____

Sheet__ of __

Site _____

Date_____

[illegible]

QC Representative _____ Date _____

Test Conductor _____ Date _____

Figure 3-2. Data Sheet Used for Prelaunch Operations

NAA-SR-MEMO-9352

3-15. SUPPLEMENTING DOCUMENTS.

3-16. Documents which supplement the NPU Verification Log are the Discrepancy Report (AI form N23H-3), the Procedure/Design Change Notice (P/DCN), and the Engineering Order. The Discrepancy Report is used by the AI Quality Control representative to report an unsatisfactory part or material item. The P/DCN is the only document used at VAFB to authorize a procedure, equipment or materials change, or modification. The Engineering Order covers design changes, in this case, to the NPU. Engineering Orders originate at AI Canoga Park headquarters and, whereas they may be executed during NPU prelaunch operations conducted at VAFB, are not initiated by the prelaunch operations unit. These and other supplementary documents are explained in detail in Section IV of NAA-SR-MEMO-9353.

SECTION IV

QUALITY ASSURANCE TESTING

4-1. GENERAL.

4-2. This is a comprehensive series of tests performed at the SPTF to assure that the NPU has not been damaged in transit from Canoga Park and meets all pre-launch standards and specifications. The test program includes detailed visual inspection of the NPU system and components, followed by a series of continuity, functional and startup sequence tests. Activities included in this phase of SPTF prelaunch operations are illustrated in Figure 4-1 by a flow sequence diagram.

4-3. RESPONSIBILITY.

4-4. PRELAUNCH TESTING OPERATIONS. Quality assurance tests are performed under the cognizance of the Test Conductor with the assistance of the Assistant Test Conductors (ATC). Handling operations are performed by a handling crew under the direction of the Mechanical Engineer. Electrical tests are directed by the ATC, Electrical, and performed by the technicians assigned to his group. The ATC, Reactor Systems, directs and monitors all operations related to the reactor. Performance of the tests and related activities is carried out by the technicians assigned to the groups.

4-5. QUALITY CONTROL. Test results and repairs or modifications, if any, are monitored by the Quality Control (QC) representative who is responsible for ensuring that NAA quality standards are maintained throughout the prelaunch operations.

4-6. INDUSTRIAL HEALTH AND SAFETY. The safety aspect of the testing program is monitored by the Health and Safety Administrator. It is his responsibility to assist the Test Conductor in ensuring that all operations are conducted in accordance with prescribed Health and Safety regulations and procedures.

4-7. DOCUMENTATION.

4-8. All tests shall be performed in accordance with the procedures set forth in this manual and the checklists provided in the NPU Verification Log (Section III, paragraphs 3-3 through 3-9). Each step in the NPU Verification Log shall be signed off as it is completed. Pages containing uncompleted steps shall be flagged with a red signal tab to call attention to an incomplete page.

Figure 4-1. Flow Sequence Diagram, SPTF Quality Assurance Testing Activities

NOTE

Complete documentation of all activities and operations shall be provided as described in Section IV, NAA-SR-MEMO 9353, SPTF Operations Manual.

4-9. RECEIVING INSPECTION.

4-10. Receiving inspection shall be performed following arrival of the NPU system at the SPTF. The inspection shall be initiated in accordance with the NPU Verification Log checklist after the shipping containers are off-loaded in the SPTF.

4-11. PURPOSE. The purpose of the receiving inspection is to ascertain the physical condition of the NPU systems upon arrival at the SPTF. The inspection is to establish acceptability of the NPU systems for further tests and assembly.

4-12. SCOPE OF THE RECEIVING INSPECTION. The receiving inspection constitutes a visual inspection and evaluation which is divided into three categories as follows:

- a. Evaluation of trip log and records.
- b. Visual inspection of shipping containers.
- c. Visual inspection of shipping container interiors and contents.

4-13. Each procedural step which follows refers to a related checklist in the NPU Verification Log. The procedures presented in this manual provide the information necessary to performance of the inspection, whereas the verification log checklists includes individual items to be checked.

4-14. EQUIPMENT REQUIREMENTS. This inspection consists of examining the shipping containers for evidence of physical damage which may have occurred during transit or off-loading. Equipment required for the inspection is as follows:

- a. NPU Shipping Container Sling.
- b. Reflector Shipping Container Handling Sling.
- c. Heat Shield Shipping Container Handling Sling.
- d. Tilt Sling.
- e. Hydra-Set.
- f. Reflector Assembly Handling Fixture.

4-15. TRIP LOG EVALUATION. Evaluate the trip log, prior to opening the shipping containers, to determine whether any of the shipping parameters were exceeded. This evaluation is performed before the containers are off-loaded in the SPTF high bay area. Perform the trip log evaluation as follows:

- a. Remove Impact-O-Graph record from NPU and reflector shipping containers.
- b. Check the Impact-O-Graph record for evidence of violent starts, stops, and/or jolts in accordance with the verification log checklist.

NOTE

A recorded shock reading in excess of 2g is considered excessive and is cause for minute examination of shipping container contents.

- c. Examine the trip log entries for evidence of abnormal conditions encountered during transit.
- d. Compare recorder charts with the trip log entries for evidence of possible erratic or intermittent operation of the recorders.
- e. Evaluate factors checked to insure there are no abnormal conditions which could present a hazard if the shipping containers were opened in the SPTF.

NOTE

The initial procedures following off-loading are similar to those included in the Shipping Manual, NAA-SR-MEMO-9351. However, they serve to substantiate previous checks, prior to opening the shipping containers.

4-16. UNPACKAGING PROCEDURE.

4-17. Open and inspect the contents of each shipping container in turn, following the sequence given in this procedure. Inspect for evidence of physical damage, moisture, or corrosion which may effect performance or reliability of the component. Remove the contents of the containers only after ascertaining that doing so does not present a hazard to facility personnel.

NOTE

Damage assessment shall be performed by the Quality-Control (QC) representative and AI Test Conductor.

4-18. NPU UNPACKAGING PROCEDURE. Open the NPU shipping container and remove the NPU per the following sequential steps.

NOTE

All NPU related handling and moving operations are performed in accordance with established handling procedures, under the direction of the Mechanical Engineer in charge of handling and assembly operations.

- a. Loosen captive bolts holding upper outer half of container to lower half.
- b. Connect Hydra-Set and NPU Shipping Container Sling to the crane. Hoist and position sling over top half of container and attach sling to the container upper outer cover eye bolts.
- c. Connect and man tag lines.
- d. Using the crane, lift upper outer half of container off lower outer half. Set the upper half aside, following standard handling procedures.
- e. Disconnect sling and tag lines and prepare to remove the upper inner half of the container.
- f. Disconnect the inert gas pressure system and vent pressure from the container.
- g. Remove the upper inner half of the container, following the procedure set forth in foregoing steps b through e.
- h. Inspect the interior and contents for evidence of physical damage, moisture or corrosion. If contents appear satisfactory, proceed to the next step.
- i. Remove NPU Shipping Container Sling from the crane, and install the Tilt Sling.
- j. Move crane into position over NPU and prepare to lift NPU from shipping container.
- k. Attach tilt sling to NPU handling fixture and, using first the Hydra-Set then the crane hoist, carefully lift the NPU from the shipping container.
- l. Move the NPU to a clear area and carefully rotate the NPU to a vertical position, using the tilt sling.
- m. Unzip and remove the plastic envelope from the NPU per standard handling practice.
- n. Move NPU over the vertical support stand. Using the Hydra-Set, carefully lower the NPU into position on the support stand.
- o. Secure the NPU to the support stand.
- p. Erect appropriate safety barricades and signs about the NPU, designating the area as a controlled access area (See NAA-SR-MEMO-9353, paragraph 5-74).

- q. Prepare plastic envelope for temporary storage.
- r. Detach handling fixture from the NPU and lift the fixture clear of the NPU.
- s. Move handling fixture to a temporary storage area and detach fixture and tilt sling.
- t. Install shipping container sling on crane. Using the crane, reload the shipping container and move it to the designated storage area.

4-19. REFLECTOR ASSEMBLY UNPACKAGING. The following equipment is required for unpackaging of the reflector assembly:

- 1. Hydra-Set.
- 2. Reflector Assembly Shipping Container Sling.
- 3. Reflector Handling Fixture.

Prepare a work bench or table to receive the reflectors by providing a clean surface covered with plastic sheet. Three men are required for the unpacking operation, as follows: one man to remove the toggle clamps while the other two hold the reflectors in place; each of these two men can then be assisted by the third man in removing the halves and placing them on the previously prepared work surface, parting plane down. In addition, the reactor core simulator must be available to accept the reflector assembly following removal from the shipping container. Proceed to unpackage the reflector as follows:

- a. Ensure that core simulator has been placed on the work bench, or in a location designated by the Test Conductor.
- b. Connect the Reflector Handling Fixture to the Hydra-Set, and move crane into position over the shipping container.
- c. Loosen and detach the bolts holding the shipping container lid in place.
- d. Manually lift the shipping container lid off and set it aside.
- e. Visually inspect the interior of the shipping container for evidence of moisture, corrosion or damage from shock or impact. Proceed to next step if contents appear satisfactory.
- f. Lower the handling fixture into place over one of the reflector halves and connect to the reflector half.
- g. Remove reflector fastening hardware and, using the Hydra-Set, carefully lift the reflector half clear of the shipping container.

- h. Move the reflector half to the core simulator and install.
- i. Repeat steps f through h for removal of the other reflector half.
- j. Replace Reflector Handling Fixture with the shipping container sling.
- k. Replace top on reflector shipping container and secure.
- l. Using the crane, pick up and move the shipping container to the storage area.
- m. Remove shipping container sling from the overhead crane.

4-20. HEAT SHIELD UNPACKAGING PROCEDURE. The following equipment is required for unpackaging of the ejectable heat shields:

- 1. Heat Shield Shipping Container Sling.
- 2. Hydra-Set installed on the overhead crane.

Open the heat shield shipping container for removal and inspection of the heat shields as follows:

- a. Install shipping container sling on the crane. Hoist the sling to a height sufficient to clear the heat shield shipping container and position crane so sling is suspended over the container.
- b. Lower sling and attach it to the upper half of the shipping container.
- c. Unfasten the container closure hardware.
- d. Lift the upper half of the container off and move it to a convenient area nearby for temporary storage.
- e. Examine the heat shields for evidence of shipping damage before removing them from the container.
- f. Check the desiccant for indication of excess moisture in the container.
- g. Upon QC representative and Test Conductor approval, proceed to remove the heat shield halves from the shipping container. The halves are manually lifted out by two men, removing one shield half at a time.

CAUTION

Heat shield halves are extremely light. Provide sufficient support to prevent damage to the shield halves during handling operations.

- h. Inspect heat shield half for damage.

- i. Set heat shield aside, or return to container as directed by the Test Conductor, providing adequate protection during the unpackaging and inspection interim storage period.
- j. Remove the second half of the heat shield in the manner outlined in steps g through i.
- k. Return top half to shipping container, following the removal procedure in reverse order.
- l. Move shipping container to storage area and remove sling from the overhead crane.

4-21. NPU SYSTEM INSPECTION PROCEDURES.

4-22. PURPOSE AND SCOPE. The procedures presented in the following paragraphs constitute a visual inspection of NPU system components. The purpose is to verify the basic electrical and mechanical integrity of system components and structures. Included in the inspection are close examination of the NaK system, the NPU wiring system and associated hardware, the reflector assembly, and the ejectable heat shields.

4-23. NPU SYSTEM STATUS. Status of individual system components is unchanged from that upon completion of unpackaging operations. This is as follows:

- a. NPU mounted on vertical support stand with plastic cover removed.
- b. Reflector mounted on core simulator located at work bench.
- c. Heat shields unpackaged, and in temporary storage.

NOTE

Inspection of the heat shields shall be scheduled at the discretion of the Test Conductor, as convenient to related operations.

4-24. VISUAL INSPECTION. Visually inspect NPU mechanical and electrical components, hardware and wiring harness for evidence of physical damage, looseness or other anomalies. Due to the large number of individual items included in this inspection, it is not practical to itemize each item on the NPU verification log. To preclude the possibility of overlooking individual items, the inspection has been divided into areas as identified in Figures 4-2 and 4-3, and listed accordingly in the NPU Verification Log. Inspect the applicable items for evidence of the following:

- a. Broken, missing or improperly installed lockwires.
- b. Chafed, bent or damaged structural members or components.

9-16-64

7561-1250

Figure 4-2. Inspection Area Identification for NPU Base Section

10FS-60004 (Ref.)

To be supplied by LMSC:

1.	High vacuum silicon grease (LMSC spec. LAC 34 4074		
2.	LS8517VT3-1	Screw	59 required
3.	LS8517VT3-2	Screw	5
	LS8859-5	Nut	64
	LS8762-4-10	Bolt	16
	LS8859-4	Nut	16
	NAS1197-416L	Washer	16
3.	1366230-1	Bond strap	
4.	1339705-501	Mating ring	1
5.	1339706-501	Shroud assy.	1

(Ref. NA0113-007)

To be supplied by AI:

1.	DT42G048T12	Screw	8
2.	MS20995N32	Lockwire	A/R
3.	0.029 in. (21 Ga.)	Nichrome wire	A/R
4.	0.023 in. (23 Ga.)	Nichrome wire	A/R
5.	NE10FS-24-015	Squib	40

10FS-60005 (Ref.)

NPU FINAL ASSY.

1.	10FSM1-61042	Heat shield installation	2
	02013-13, -15	Strap assy's	1 ea.
	10FS-86009	Pin puller	1
	- - -	Adj. Screw (upper & lower)	2 ea.
	10FS-140009	Spring	4
	- - -	Plunger & repair clips	4 ea.
	- - -	Retainer block	4
	- - -	Flight nut	2
	- - -	Nut-fitup	2
2.	10FSM1-13015	Shield assy., Radiation	1
3.	10FS-20001 (Ref.)	Instrument Installation, NPU	
	10FS-20016-4	Safe plug	1
	10FS-20016-3	Arm plug	1
	10FS-21012 (Ref.)	Instal. plug	1
	10FS-20016-4	Safe plug	1
	10FS-20016-3	Arm plug	1
	10FS-21012 (Ref.)	Instal. plug	1
	NFS-20014	Accel. assy.	1

10FS-14001 (Ref.)

HEAT BARRIER INSTALLATION

1.	10FS-14002	Heat barrier	1
2.	10FS-14003	Heat barrier	1
3.	10FS-61007	Door assy., Inst. cmpt.	1
4.	Eastman 910	Adhesive	1 tube (8 oz)
5.	- - -	Toluene	1 gal
6.	- - -	Lint free cloth	

10FS-1101 (Ref.)

REFLECTOR ASSY. & INSTALLATION

1.	10FS-11003-3	Reflector assy.	1 required
2.	10FS-11003-4	Reflector assy.	1
3.	10FSM1-11053	Spring, eject	4
4.	10FSM1-11160	Insulator, eject	4
5.	10FS-11007	Adapter, eject spring	4
6.	10FSM1-11129-3	Bolt, EABRD	1*
7.	10FSM1-11129-4	Bolt, EABRD	1*
8.	10FS-11052	EABRD	1
9.	10FSM1-11130-3	Band assy., short	1
10.	10FSM1-11130-8	Band assy., long	1
11.	NAS 1327 R3	Pin, TABRD	2
12.	NAS 1287-08	Nut, TABRD	2
13.	10FS-11027	Cable assy.	2
14.	10FSM1-11043-3	Lock assy.	2
15.	10FSM1-11043-12	Lock assy.	2
16.	10FSM1-12012-5	Pin, hinge	4
17.	AN 960-C416L	Washer, hinge pin	4
18.	AN 381-2-8	Cotter pin (hinge pin)	4
19.	10FSM1-11156-5	Insulator strip	4
20.	10FSM1-11156-4	Insulator strip	3
21.	LD 122-0022-0137	Pin, cable	4
22.	10FS-11022	Pin, cable retention	4
23.	AN 960-C3	Washer, EABRD	2*
24.	79LH 1660-38	Nut, EABRD	2*

*Obsolete - new design unavailable

Figure 4-3. NPU Configuration Check List

- c. Loosely mounted hardware, or missing hardware.
- d. Loose connections, clamps or fittings.
- e. Inspect electrical wiring for evidence of chafed or damaged wires or wiring looms.
- f. Inspect wiring harnesses for evidence of loose or damaged connectors, loose or missing cable ties or clamps, loose or missing grommets.

4-25. NaK SYSTEM INSPECTION. This constitutes a visual inspection of the NaK system to verify system integrity and condition. It includes inspection of the thermo-electric power converter portion of the system and the reactor portion. No special equipment is required for performance of the inspection. A magnifying glass is helpful in the event a defect is discovered and must be given a minute examination.

4-26. Follow the order of inspection given in the NPU Verification Log, checking off each item as it is completed. Inspect each portion of the system for the following:

- a. Dented, scratched, or deformed NaK tubing or plumbing.
- b. Tubing or plumbing which has pulled loose from the anchoring or supporting brackets or attachment points.
- c. Loose, damaged or missing hardware which is associated with the system.
- d. Evidence of NaK leaks or suspected leaks as may be indicated by encrusted beads of NaK on the tubing.

4-27. Evidence of damage to the NaK system shall be assessed by the Test Conductor to determine the effect of the damage on system operability and/or the feasibility of repair. Acceptance of any abnormal condition is at the discretion of the Engineering Supervisor with the recommendations of the Test Conductor and QC representative.

4-28. The NPU shall be returned to the Santa Susana facility in the event a NaK leak is discovered. Instructions for draining the NaK system are provided in Section VII of this manual.

4-29. REFLECTOR INSPECTION AND PREPARATION.

4-30. PURPOSE AND SCOPE. The purpose of these operations is to verify the mechanical integrity of the reflectory assembly and prepare the assembly for installation on the NPU.

4-31. REFLECTOR ASSEMBLY STATUS. The inspection is initiated after the reflector halves have been removed from the shipping container and mounted on the core simulator fixture. Status of the mounted reflector assembly is as follows:

- a. Void filler blocks attached.
- b. Small parts at hand for installation on reflector.
- c. Preliminary visual inspection of reflector halves completed, and accountability of small parts verified.

4-32. REFLECTOR CHECKOUT AND MAKE-READY PROCEDURE. Check the reflector assembly and associated components while preparing the assembly for installation on the NPU, as follows:

4-33. Removal of Void Filler Blocks.

- a. Remove the void filler blocks from fine control drum -Z as follows:
 1. First loosen the two bolts on the unit face block and the four bolts on the void filler blocks.
 2. Remove the two self-locking bolts which are holding the large unit face block to the small cavity block (top 2 bolts).
 3. Remove the two self-locking bolts which are holding the large unit face block to the large cavity block (bottom 2 bolts).
 4. Remove the two bolts and washers holding the large unit face filler block to the reflector assembly. The large unit face block comes off with spacers intact. Do not remove spacers from unit face block.
 5. Remove the one small cavity block.
 6. Remove the one large cavity block.
 7. Place all above filler block assemblies and associated hardware in a storage box labeled for this drum position.
- b. Remove the void filler blocks from coarse control drum -Z as follows:
 1. First loosen the two bolts on the unit face block and the four bolts on the void filler blocks.
 2. Remove the two self-locking bolts which are holding the small unit face block to the large cavity block (top 2 bolts).
 3. Remove the two self-locking bolts which are holding the small unit face block to the small cavity block (bottom 2 bolts).

4. Remove the two bolts and washers holding the small unit face filler block to the reflector assembly. The small unit face block comes off with spacers intact. Do not remove spacers from unit face block.

5. Remove the one large cavity block.

6. Remove the one small cavity block.

7. Place all above filler block assemblies and associated hardware in the storage box labeled for this drum position.

c. Remove the void filler blocks from coarse control drum +Z by repeating the procedure outlined in step a.

d. Remove the void filler blocks from fine control drum +Z by repeating the procedure outlined in step b.

4-34. Removal of Key Lock Barrels. Remove key lock barrels by inserting key, if not in place, with straight side of key towards drum. Revolve key 180° counter clockwise, grasp barrel and revolve 90° counter clockwise, pull out and away from reflector, permit to hang on chain but clear of drum.

4-35. Pin Puller Removal.

a. Raise antivibration latches and secure in raised position. Obtain or prepare installation location (Z+ Z-, fine coarse) identification tags and boxes.

b. Remove only one pin puller. Remove dummy squibs and save for subsequent operations. Tag pin puller as to system and location and box for storage. Set bolts aside.

c. Repeat step b for each of the other 3 pin pullers.

d. Inspect bolts and place all good bolts in a box. If necessary, obtain replacement and four spares (all molykoted) and place in box. Seal and identify as FLIGHT SYSTEM SQUIB ACTUATED PIN PULLER BOLTS.

4-36. Helicoil Removal and Replacement.

a. Remove all helicoil inserts from holes tapped for squib actuated pin puller use.

b. Use alcohol/acetone and swabs to clean holes; dry, and inspect with otoscope. Reclean until all debris has been removed.

c. Install new helicoils.

d. Install "U" brackets using short molykoted allen head cap screws. (Heads painted red.)

e. Obtain tooling pin pullers (spares can be used). Identify and check as to position. Install dummy squibs; check as follows:

1. Check dummy squib orientation in tooling units (key location) with the wiring harness connectors (key slots). If these do not correspond, remove dummy squibs and shim and retorque so that the keyway in the squibs line up within $\pm 45^\circ$ of the wiring harness connector. Make and identify maps of these orientations tied into the four positions involved.

2. Install tooling units using short allen head cap screws which have been painted red on the heads and molykoted. Torque and connect wire connectors but do not lock wire anything.

3. Lower antivibration latches and torque nuts.

4-37. Stepper Motor Removal.

a. Remove stepper motor +Z as follows:

1. Cut lock wire and disconnect both connectors for +Z motor.
2. Cut band at brake.
3. Cut lock wire and loosen screws holding motor to bearing bracket.
4. Run out screws one at a time and remove tab washer.
5. Tag tab washers as to position and store.
6. Remove motor.

b. Repeat for -Z motor.

4-38. Check Cogging and Brake Torque.

a. Clamp motor in vertical position with shaft up and brake release cable and battery attached to brake receptacle. Use torque meter with adapter to fit shaft and connect to shaft snugly. Release brake momentarily and check torque at three positions about 120° apart.

b. Measure brake holding torque at last position.

Do not slip brake any more than essential for this measurement.

- c. Repeat (a) for other motor.
- d. Repeat (b) for other motor.

4-39. Remove Hinge Pins.

- a. Make sure protective screen is in place.
- b. Remove snap rings with pliers and pull pins.
- c. Label and store pins which have been removed.

4-40. Remove EABRD ISOLATION STRIP.

- a. Remove isolation strip if installed.
- b. Remove light socket and connect with 10 feet of cord to permit monitoring light under all conditions.
- c. Clamp light cord out of way with hose clamp until needed.

4-41. Snap-In Springs Removal.

- a. Cut lock wire and remove both spring assemblies. Tag as to location.
- b. Check and record torque as follows:
 - 1. With the spring assembly firmly held on a flat surface with the open side up and the two mounting bolt holes to the operator's left, the large notch of the spline (the "A" notch) will fall somewhere near 6 o'clock position.
 - 2. Insert the short 3/8-inch section of allen wrench into the spline, attach a torque meter and revolve clockwise until the "A" notch has revolved over 90° and is aligned with the center line between the two mounting bolts.

NOTE

This is the "full out" torque and can be read.

- 3. Relax the torque meter and permit the spring to drive the "A" notch to alignment with the farther of the two mounting holes.

NOTE

This corresponds to the "full in" torque and can now be read.
See sketch on following page.

- c. Box and store temporarily.

Orientation of reflector snap-in spring assembly.

4-42. Check Drum Bearing Friction.

a. Using either TC48RL or TC20RL torque meter, depending on friction values encountered, put adapter onto spline and starting at "full out" and rotating the drum "in," take measurements at the five positions below:

1. on the FULL OUT cam.
2. just off the FULL OUT cam.
3. at mid point.
4. just short of the FULL IN cam.
5. on the FULL IN cam.

NOTE

There is no controlling specification on the first and last items above, but these are necessary to insure that the series has been completed. When this has been done, reverse the direction of rotation "out" and repeat the measurements. Replace the key lock barrel and secure the drum, leaving the key in place.

- b. Repeat (a) for Z- fine control drum.
- c. Repeat (a) for Z+ coarse control drum.
- d. Repeat (a) for Z- coarse control drum.

4-43. Replace Stepper Motor.

- a. Lower motor to engage gear and insert only the screws.
- b. Run screws down hard tight only do not torque or lock wire.
- c. Replace connectors; snug tight but do not lock wire.
- d. Recheck backlash on each fine control drum.

4-44. Replace Snap-in Springs.

- a. Replace units according to tag identification.
- b. Tighten screws but do not lock wire.
- c. Recheck assembled spring torque for both drums at FULL IN and FULL OUT positions.

4-45. Connection of Interface Cabling and Checkout.

- a. Set up reflector halves in a vertical position away from system on AGE core simulation fixture.
- b. Connect reflector assembly to NPU with cables (only needed for stepper motor circuits) batteries can be used with manual switches.
- c. Install pin puller for fine control drum. Do not connect electrically.
- d. Raise antivibration latches and secure in the raised position.
- e. Run both actuators 4° in each direction. Drop antivibration latches onto pins. If they fall or can be easily lowered, proceed with (g) below, if not, complete (f) below.
- f. Relax bolts and revolve stepper motor until latch drops. Tighten two bolts and raise antivibration latch and repeat (e) above. Repeat until latch is easily engaged.
- g. Remove one bolt and install tab washer on this bolt and tighten. Bend washer if necessary. Put new washers on other two bolts as above.

4-46. ELECTRICAL REFERENCE CHECKS.

4-47. PURPOSE. The purpose of this series of electrical checks is to verify the electrical integrity of the NPU electrical system and instrumentation circuits prior to applying power to the NPU system for operational checkout. Satisfactory completion of the checks ensures that power may be applied to the NPU without danger of electrical burnout due to short circuits.

4-48. SCOPE. The electrical checks are comprised of a series of static continuity, resistance, and voltage breakdown checks which will disclose any circuit anomalies which may have been incurred in transit or handling of the NPU. The series of checks include the following:

- a. Power converter continuity.
- b. Relay status check.
- c. Insulation resistance check, and circuit isolation.
- d. Circuit loop resistance.

4-49. NPU STATUS. The electrical checks are performed following completion of the NPU and reflector assembly inspections. The NPU is in a vertical position, on the support stand; the reflector assembly is mounted on the core simulator and electrically mated to the NPU by means of jumper cables.

4-50. EQUIPMENT REQUIRED. The following equipment is required for performance of the electrical reference checks:

- a. Interface rack and associated jumper cables.
- b. Multimeter.
- c. Milliohmeter.
- d. Insulation resistance tester (megger).
- e. Impedance Bridge.

4-51. PREPARATION. Prepare the NPU for the electrical checks by installing the jumper cables and completing connection of the cables to the interface rack. The number of mating and demating operations of NPU interface connectors and test plugs shall be held to a minimum to minimize potential damage to the connectors. Proceed to connect the interface rack as follows:

- a. Inspect jumper cable connectors for the following conditions:
 1. Damaged connector shells and/or nuts.
 2. Bent pins or damaged insulation in plug and/or socket.
 3. Correct identification, to facilitate installation.
 4. Cleanliness and freedom from foreign material.
- b. Verify serviceable condition of jumper cables.
- c. Verify connection of jumper cables to interface rack.
- d. Mate jumper cable connectors to NPU interface and test plug connectors.

4-52. POWER CONVERTER CONTINUITY AND MODULE RESISTANCE CHECK.

4-53. PURPOSE AND SCOPE. The purpose of these checks is to verify the electrical integrity of the thermoelectric power conversion circuits after each physical move of the NPU. The checks consist of measuring the resistance (continuity) from top and bottom radiator of each leg pair, and total resistance of the converter circuit. In addition, circuit resistance to ground is checked to verify absence of high resistance leakage.

4-54. EQUIPMENT REQUIREMENTS. The milliohmeter and applicable NPU log data sheet are required for performance of the check.

4-55. POWER CONVERTER CONTINUITY CHECK. Perform the converter continuity check as follows:

CAUTION

Make certain that test leads of the same polarity are paired together. The leads marked C (current) must always be clipped outboard of the voltage (V) leads in order to obtain a proper impedance reading.

- a. Measure resistance from top and bottom radiator of each leg pair, following the order given in the applicable NPU log data sheet.

b. Measure converter resistance by connecting the milliohmeter leads to the converter leg voltage taps listed in the data sheet; record results.

c. Record time of day, relative humidity and temperature in the REMARKS section of the applicable NPU log page.

4-56. POWER CONVERTER RESISTANCE CHECK. Continue the check, measuring total converter circuit resistance as follows:

a. Connect milliohmeter leads to converter leg 15(+) and 16(-). Measure and record resistance on data sheet.

NOTE

If converter is covered by the heat shield or handling fixture, this measurement shall be made at connector P2401 as outlined in the following steps.

b. To measure resistance between CL15 and CL16 from P2401, using the four wire resistance measurement technique, connect the milliohmeter leads as follows:

1. Disconnect P2402 and P2501.
2. Connect red voltage lead to pin A.
3. Connect red current lead to pin B.
4. Connect black voltage lead to pin C of P2401.
5. Connect black current lead to pin D.
6. Read and record resistance measurement.

4-57. CONVERTER INSULATION CHECK. This check is performed to verify electrical isolation of the power converter from the NPU ground, by measuring electrical resistance between the converter and NPU ground. The megger is used for making the check. Proceed to check insulation resistance as follows:

a. Isolate power converter from test circuits by disconnecting connectors P-2401 and P-2402 from the junction cabinet.

b. Place test probes between P-2401-A and TB501-Y, and read resistance shown on megger meter.

NOTE

Alternate test points designated by the ATC, Electrical may be used for performance of this check if the listed terminals are not readily accessible.

SNAPSHOT

NPU VERIFICATION LOG DATA SHEET NO. 4-1

Prelaunch Operation: _____

Reference: NAA-SR-MEMO 9352, Par. 4-74/75

Test Equipment Req'd: Multimeter, Milliohmeter

Sheet 1 of 1

Site SPTF

Date _____

1	2	3	4	5	6	7	8	9	10
VOLTAGE TAP	CONVERTER LEG		RESISTANCE		PARALLEL	RESIST-	PARALLEL	RESIST-	
	FROM	TO	(milliohms)		LEGS	ANCE (milliohms)	LEGS	ANCE (milliohms)	
VT-12	16	19			10-11		38-39		
VT-11	19	24			12-13		40-41		
VT-10	24	27			14-15		42-43		
VT-9	27	32			16-17		44-45		
VT-8	32	35			18-19		46-47		
VT-7	35	40			20-21		48-49		
VT-6	40	44			22-23				
VT-5	44	47			24-25				
VT-4	47	12			26-27				
VT-3	12	15			28-29				
					30-31				
					32-33				
					34-35				
					36-37				

NAA-SR-MEMO-9352

Technician _____ Date _____

QC Representative _____ Date _____

Test Conductor _____ Date _____

- c. Record converter resistance to ground on applicable page of NPU log.
- d. Reconnect P-2401 and P-2402 after completing the checks.

4-58. RELAY STATUS CHECK.

4-59. PURPOSE AND SCOPE. The relay status check is a routine check which is performed prior to application of power to the NPU electrical system. Purpose of the check is to verify latching control relay status, i. e., whether contacts are open or closed, to preclude the possibility of an electrical malfunction when power is applied to the NPU busses. Relay status is determined by checking continuity across the relay contacts.

4-60. EQUIPMENT REQUIREMENTS. A multimeter is the only instrument necessary for performance of this check. The related NPU log Data Sheet is required for recording relay status.

4-61. PROCEDURE. Establish relay status in the following manner:

- a. Apply multimeter probes to the test points itemized in the applicable NPU log Data Sheet.
- b. Observe whether the meter indicates continuity or absence of continuity.

NOTE

Resultant readings indicate presence or absence of continuity, thus indicating whether relay points are open or closed.

- c. Record results on Data Sheet by entering the letter O or C in the applicable column to indicate open or closed condition of the relay points.
- d. Record actual measured resistance where a finite resistance is specified on the data sheet.

NOTE

Upon completion of the relay status check, the Test Conductor or his designee shall examine each data point before proceeding to the next test phase.

- e. Establish proper relay status before continuing to the next testing phase.

4-62. NPU INSULATION RESISTANCE CHECK.

4-63. PURPOSE AND SCOPE. The purpose of this check is to verify that major NPU circuits are satisfactorily isolated from system structures, and are not electrically grounded. The check consists of checking all major circuits for evidence of current leakage to ground.

4-64. EQUIPMENT REQUIREMENTS. The megger is the only instrument used in performing the check. Data is recorded in the applicable NPU log Data Sheet.

4-65. PROCEDURE. Check insulation resistance by applying megger probes to applicable terminals at the interface rack as called for in the data sheet. Proceed to measure resistance from terminal point to J501-Y (NPU ground) as follows:

- a. Where only a single data blank appears in column 8 of the data sheet, insert a megger probe into each interface rack test point specified in column 3. Note and record megger reading.
- b. Where a double data blank is provided in column 8 insert a megger probe in each of the test points specified in columns 2 and 3 of the data sheet. Note and record megger reading.
- c. Where data blank in column 8 is crossed out, disregard that line of the data sheet and proceed to the next applicable line of the data sheet.

NOTE

Insulation resistance shall be no less than 2 megohms.

- d. Enter a check mark (✓) in column 8 if circuit resistance is greater than 2 megohms. It is not necessary to record actual resistance value.
- e. If circuit resistance is 2 megohms or less, enter measured value in column 8 and circle entry. Enter applicable remarks in the REMARKS section of the related page of the NPU Verification Log.
- f. Upon completion of the check, obtain Test Conductor permission to proceed to the next test phase.

4-66. CIRCUIT ISOLATION RESISTANCE CHECK.

4-67. PURPOSE AND SCOPE. The purpose of this check is to verify the electrical isolation of major NPU circuits. It consists of checking insulation resistance between the individual circuits.

4-68. EQUIPMENT REQUIREMENTS. Requirements are identical to those of the previous check (see paragraph 4-83).

4-69. PROCEDURE. Check circuit isolation by applying megger probes to applicable terminals at the interface rack as called for in the data sheet. Proceed to measure resistance between the specified terminals as follows:

a. Repeat steps a through d of paragraph 4-84, as applicable to column 9 of the data sheet.

b. Upon completion of the check, recheck those circuits showing less than 2 megohms leakage resistance. Correct or determine cause for the anomaly, recording applicable information in the REMARKS section of the related NPU log page.

NOTE

Cause of the anomaly shall first be attempted at the NPU interface points. Proceeding beyond the interface, especially breaking into a connector, shall be done only with express approval of the Test Conductor.

c. Obtain Test Conductor permission to proceed to the next test phase.

4-70. CIRCUIT LOOP RESISTANCE CHECK.

4-71. PURPOSE AND SCOPE. The purpose of this check is to determine the circuit loop resistance of all NPU circuits available at the NPU/Agema interface and NPU test plugs. Values measured at this time are compared to those which were recorded during tests completed prior to shipment to VAFB. Comparison of the two values enables evaluation and verification of NPU circuit condition.

4-72. EQUIPMENT REQUIREMENTS. The universal impedance bridge is used in performing this check. The applicable NPU log Data Sheet is necessary.

4-73. PROCEDURE. Prepare and calibrate the impedance bridge and perform the subsequent circuit check as outlined in the steps which follow.

4-74. Impedance Bridge Preparation.

a. Connect a RED test lead to positive terminal of the bridge (left-hand terminal of the unknown L-R connections when viewing bridge from the manual operation position).

b. Connect a BLACK test lead to the other unknown L-R connection of the bridge.

- c. Set dc generator voltage switch to LOW position.

CAUTION

Do not set generator switch to HIGH position. Failure to follow this precaution can result in application of excessive voltage to the NPU.

- d. Unlock galvanometer and adjust zero as necessary.
- e. Turn AMP control clockwise to turn on power supply. The red indicator light to the left of the amp control switch should light.
- f. Turn the OSC control counter-clockwise for dc voltage.
- g. Set selector switch to $R \times 1$ unless specified otherwise on the data sheet.
- h. Set multiplier switch to range specified in column 4 of the data sheet, for the circuit under test. If no range is specified in the data sheet, adjust multiplier switch as required by the expected reading.

CAUTION

Do not use $R \times 1$ or $R \times 0.1$ multiplier switch positions when checking relay operating coil circuits. Failure to observe this precaution can result in inadvertent relay operation.

- i. Set detector switch to the SHUNTED METER position.

4-75. Loop Resistance Check. Proceed to take measurements between the interface rack terminals listed under the FROM and TO columns of the data sheet as follows:

NOTE

Forward and reverse resistances are measured to determine the condition of non-linear circuit elements.

- a. Connect the RED lead to the FROM terminal of the interface rack, and the BLACK lead to the TO terminal of the interface rack test points as specified in columns 2 and 3 of the data sheet.
- b. Set generator switch to INTERNAL DC position.

c. Adjust main dial for null, increasing detector sensitivity as null is approached by moving the detector switch to DIRECT METER position.

NOTE

If a balance cannot be obtained, adjust range switch to a new value and null the bridge using the main dial. Observe previous CAUTION note.

d. Record loop resistance value given by the product of main dial reading and multiplier dial reading. Enter reading in column 6 of data sheet.

e. Set generator switch to EXT DET and the detector switch to SHUNTED METER positions before disconnecting from the measured circuit.

4-76. A reverse voltage loop resistance measurement is required on those items for which a specific instrument range is specified (column 5 of data sheet). The following steps are applicable to checking this resistance measurement:

- a. Interchange the RED and BLACK test leads at the interface rack.
- b. Set generator switch to INTERNAL DC position.
- c. Adjust main dial for null, increasing detector sensitivity as null is approached by moving the detector switch to DIRECT METER position.

NOTE

If a balance cannot be obtained, adjust range switch to a new value and null the bridge with main dial.

d. Record measured reverse loop resistance value in column 8 of data sheet.

e. Upon completion of the test, secure the impedance bridge as follows:

1. Lock the galvanometer.
2. Set the AMP switch to OFF position.
3. Return the test instrument to the Instrument Laboratory.

4-77. ELECTRICAL SYSTEM FUNCTIONAL CHECKS.

4-78. The functional checks listed in the following paragraph are performed when the NPU is not mated to a launch vehicle.

4-79. PURPOSE. Functional checks consist of applying power and test signals to the NPU and verifying proper operation of associated electrical systems and components. NPU system conditions and response checked at this time are as follows:

- a. Launch and ascent condition.
- b. Pre-orbital condition.
- c. Orbit established.
- d. Orbit stabilized.
- e. Primary loop preheat.
- f. Malfunction tests.
- g. Converter degradation.
- h. Converter continuity.
- i. ESD/ELD checkout and response.
- j. RTD test.

4-80. NPU STATUS. NPU status is as follows:

- a. The NPU is mounted on the vertical support stand with the work stand in place.
- b. Reflector assembly is mounted on the core simulation fixture located on the work bench.
- c. Detailed visual inspection and preparation of NPU reflector, and electrical reference checks have been completed.
- d. Verify that NPU is in readiness for application of electrical power.

4-81. PREREQUISITES. Verification of Electrical System Test Set TSM-2A will have been completed prior to delivery of the flight system. Refer to NA0203-060.

4-82. EQUIPMENT REQUIREMENTS. Electrical System Test Set TSM-2A and associated test cables are the only equipment required for the performance of NPU functional checks.

4-83. TSM-2A PREPARATION. Prepare the NPU and test set cable/connector connections as listed in Section 3 of A. G. E. Operation and Maintenance-Electrical Manual, NAA-SR-MEMO-9356 Volume II.

4-84. Perform test set activation and self-test procedures as described in Section 4 of NAA-SR-MEMO-9356 Volume II.

4-85. REFLECTOR PREPARATION. Prepare the reflector assembly for operational checks by completing the following operations:

- a. Loosen and remove the pin puller mounting screws on all pin pullers.
- b. Mount pin puller U bracket fixtures on the reflector assembly.
- c. Install the pin pullers in the adjacent U bracket.
- d. Install key locks in reflector assembly.
- e. Check band status switch actuators to make certain the actuators are clear of obstructions and are operable.
- f. Check drum drive gear-pinion engagement to make certain each is properly engaged and clear of obstruction.

4-86. ELECTRICAL SYSTEM FUNCTIONAL CHECK PROCEDURES. Upon completion of the foregoing preparatory procedures, initiate the functional checks per procedures listed in Table 4-1.

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
<u>LAUNCH/ASCENT CHECK</u>			
On test set operating bay 2, turn on/operate the following:			
Circuit breaker; adjust power supply output to 30 amperes (maximum)	Pilot light on	Bay 2, Nak pump power supply	
SQUIB BUS ENABLE toggle switch	ENABLE VERI- FY indicator on	Bay 2, vehicle interface unit (VIU)	
	Channel 6 event marker (EM) on	Bay 3, events recorder (EVR)	
	RELAY POSI- TION K6 OPERATING indicator on	Bay 1, power and control system analyzer (PCSA)	
	ALL RESET indicator on	Bay 1, PCSA	
Verify status of control DRUM POSITION indicators	DRUM POSI- TION F1 and F2 OUT indicators on	Bay 2, VIU	
	DRUM POSI- TION C1 and C2 OUT indicators on	Bay 2, VIU	
Record initial drum position output voltages	DIGITAL VOLTMETER INPUT SELEC- TOR (DVM)	Bay 2, VIU	

Table 4-1. Electrical System Functional Check Procedures

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
<p>switch to position 5</p> <p>DVM switch to position 6</p> <p>DVM switch to position 7</p> <p>DVM switch to position 8</p> <p><u>PRE-ORBITAL CONDITION CHECK</u></p> <p>On test set operating bay 2, turn on/operate the following:</p> <p>VEHICLE COMMANDS REL. EXP. COMP. push-button switch</p> <p>On NPU actuate PnS-9 and PnS-10</p>	switch to position 5		
	DVM switch to position 6	Bay 2, VIU	
	DVM switch to position 7	Bay 2, VIU	
	DVM switch to position 8	Bay 2, VIU	
	EXPANSION COMPENSATOR NO. 1 and NO. 2 indicators on	Bay 2, VIU	
	EVENT MARKERS EVM-8 indicator on	Bay 2, VIU	
	RELAY POSITION K23 OPERATE indicator on	Bay 1, PCSA	
	Top indicators - C13, C14, C15, and C16 on (GO output)	Bay 1, squib circuit analyzer (SCA)	

Table 4-1. Electrical System Functional Check Procedures (Continued)

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
	Channel 10 EM on	Bay 3, EVR	
<p>NOTE</p> <p>NO-GO (red indications) indicates less than 3 amperes squib current.</p>			
	Channel 24 EM on	Bay 3, EVR	
	Channels 81 thru 84 EM on	Bay 3, EVR	
<p><u>ORBIT ESTABLISHED CHECK</u></p> <p>On test set operating bay 2, turn on/operate the following:</p> <p>VEHICLE COMMANDS AC1 pushbutton switch; note time</p>			
	Following RE- LAY POSITION OPERATE indicators are on: K1, K2, K3, K18, K19, K21 and KC	Bay 1, PCSA	
<p>NOTE</p> <p>After 50 seconds event markers 44 through 77 will operate momentarily. If full drum rotation is to be obtained remove pin pullers prior to preceeding step.</p>			
	Top indi- cators - C3 thru C11 on (GO outputs)	Bay 1, SCA	

Table 4-1. Electrical System Functional Check Procedures (Continued)
 Issued 19 February 1965

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
On NPU, release coarse control drums to actuate PnS-1 and PnS-3	EVENT MARKERS	Bay 2, VIU	
	EVM-2 and EVM-9 indicators on		
	Channels 1, 2, 3, 7, 11, 26, 41, 61 thru 64, and 71 thru 74 EM on	Bay 3, EVR	
	DRUM POSITION C1 and C2 IN indicators on	Bay 2, VIU	
	Channels 31 and 32 EM on	Bay 3, EVR	
NOTE			
Fine drums are stepping every 150 seconds after 50 second delay after startup.			
	Following START-UP CONTROLLER indicators are on in the sequence listed below:	Bay 2, VIU	
	VT-17 and VT-18		
	VT-18 and VT-19		

Table 4-1. Electrical System Functional Check Procedures (Continued)

Issued 19 February 1965

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
	VT-19 and VT-20 VT-20 and VT-17 Channels 44 thru 47 EM on	Bay 3, EVR	
NOTE			
DRUM POSITION indicators F1 and F2 will indicate as noted after several steps.			
	DRUM POSI- TION F1 and F2 OUT indi- cators off	Bay 2, VIU	
	DRUM POSI- TION F1 and F2 center indicators on	Bay 2, VIU	
	F1 OUT indi- cator off	Bay 2, VIU	___ steps
	DVM position 5 reading	Bay 3, EVR	___ volts
	DVM position 7 reading	Bay 3, EVR	___ volts
	F2 OUT indi- cator off	Bay 2, VIU	___ steps
	DVM position 5 reading	Bay 3, EVR	___ volts
	DVM position 7 reading	Bay 3, EVR	___ volts

Table 4-1 . Electrical System Functional Check Procedures (Continued)

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
Record drum position output voltages once every ten steps			
On test set operating bay 2, operate DVM switch to the following positions:		Bay 2, VIU	
Position 5	Readout	Bay 3 (Digital voltmeter (DVM))	___ volts
Position 6	Readout	Bay 3, DVM	___ volts
Position 7	Readout	Bay 3, DVM	___ volts
Position 8	Readout	Bay 3, DVM	___ volts
<u>ORBIT STABILIZED CHECK</u>			
On test set operating bay 1, turn on/operate the following:			
COMMANDS THERMAL SHIELD EJECT pushbutton switch	RELAY POSITION K4 and K14 OPERATE indicators on	Bay 1, PCSA	
	RELAY POSITION K3, K18, K19, K21 and K23 RESET indicators on	Bay 1, PCSA	
	FUSISTOR GO indicator off	Bay 1, PCSA	
	Top indicators- C1 and C2 on (GO outputs)	Bay 1, SCA	

Table 4-1. Electrical System Functional Check Procedures (Continued)

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
On test set operating bay 2 turn on/operate the following: VEHICLE COMMANDS AC2 pushbutton switch	EVENT MARKERS EVM-1 indi- cator on	Bay 2, VIU	
	THERMAL SHIELD EJECTED NO. 1 and NO. 2 indicators on	Bay 2, VIU	
	Channels 4, 25, 51 and 52 EM on	Bay 3, EVR	
	Channels 3, 7, 10, 14, 15, and 19 EM off	Bay 3, EVR	
	Following MALFUNC- TION & L.V. REFL. EJECT CIRCUIT indicators on: K7 (EVM-19) MALF. T/M K10 (EVM-5) EVENT MARKERS EVM-3 indicator on	Bay 2, VIU Bay 2, VIU	

Table 4-1 . Electrical System Functional Check Procedures (Continued)

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
	Channels 9, 23, 27, and 28 EM on	Bay 3, EVR	
	RELAY POSI- TION K12 OPERATE indicator on	Bay 1, PCSA	
NOTE			
TS-3 cannot be actuated. Low temperature malfunction condition exists due NPU being in an ambient temperature state.			
<u>PRIMARY LOOP PREHEAT</u>			
NOTE			
Controller continues to step drums until Nak temperature is at design level (TS-1 and TS-2 close). Activate TS-1 and TS-2 in accordance with the following procedure.			
On test set operating bay 1, actuate/set the following:			
Set resistance on TS-1 potentiometer to 400 ohms	Dial reads 8.0 turns	Bay 1, PCSA	
Set resistance on TS-2 potentiometer to 300 ohms	Dial reads 6.0 turns	Bay 1, PCSA	
TS-2 switch to the latch (down position)	TS-2 indi- cator on	Bay 1, PCSA	
Decrease resistance on TS-1 potentiometer in 5 ohm steps; actuate TS-1 switch to the momentary (up position)	START-UP CONTROLLER VT-13 indica- tor on	Bay 2, VIU	
	Potentiom- eter turns ratio	Bay 1, PCSA	— turns

Table 4-1. Electrical System Functional Check Procedures (Continued)

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
until START-UP CONTROLLER VT-13 indicator is energized	Circuit resistance		— Ohms
<div style="text-align: center; border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;">CAUTION</div> <p>Due to circuit heating effects TS-1 switch ON time should be kept to a minimum.</p>			
TS-1 switch to the latch (down position)	TS-1 indicator on START-UP CONTROLLER VT-13 indicator on	Bay 1, PCSA Bay 2, VIU	
	Following START-UP CONTROLLER indicators stop sequencing: VT-17, VT-18, VT-19 and VT-20	Bay 2, VIU	
	Channel 41 EM on	Bay 3, EVR	
	Channel 44 thru 47 EM off	Bay 3, EVR	
<u>Temperature Override</u>			
On test set operating bay 2, actuate the following:			
VEHICLE COMMANDS AC 7a pushbutton switch	Following START-UP CONTROLLER	Bay 2, VIU	

Table 4-1 . Electrical System Functional Check Procedures (Continued)

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
VEHICLE COMMANDS AC 7b pushbutton switch	indicators illuminate in proper sequence: VT-17, VT-18, VT-19 and VT-20		
	EVENT MARKERS EVM-18 indicator on	Bay 2, VIU	
	RELAY POSI- TION KOR OPERATE indicator on	Bay 1, PCSA	
	Channel 41 EM off	Bay 3, EVR	
	Channels 44 thru 47 EM on	Bay 3, EVR	
	Channel 41 EM on	Bay 3, EVR	
	Channels 44 thru 47 EM off	Bay 3, EVR	
	Following START-UP CONTROLLER indicators stop sequencing: VT-17, VT-18, VT-19 and VT-20	Bay 2, VIU	

Table 4-1 . Electrical System Functional Check Procedures (Continued)

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
On test set operating bay 1, actuate/set the following: TS-1 switch to off (center position) and allow circuit to stabilize Increase resistance on TS-1 potentiometer in 5 ohm steps; actuate TS-1 switch to the momentary (up posi- tion) until START-UP CONTROLLER VT-13 indicator is deenergized Set resistance on TS-1 potentiometer to 300 ohms TS-2 switch to off (center position) Set resistance on TS-2 potentiometer to 400 ohms	EVENT MARKERS EVM-18 indicator off	Bay 2, VIU	
	RELAY POSI- TION KOR RESET indi- cator on	Bay 1, PCSA	
	TS-1 indica- tor off	Bay 1, PCSA	
	START-UP CONTROLLER VT-13 indi- cator off	Bay 2, VIU	
	Potentiom- eter turns ratio	Bay 1, PCSA	_____ turns
	Circuit resistance		_____ ohms
	Dial reads 6.0 turns	Bay 1, PCSA	
	TS-2 indi- cator off	Bay 1, PCSA	
	Dial reads 8.0 turns	Bay 1, PCSA	

Table 4-1. Electrical System Functional Check Procedures (Continued)

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
TS-1 switch to latch (down position)	TS-1 indicator on	Bay 1, PCSA	
Decrease resistance on TS-2 potentiometer in 5 ohm steps; actuate TS-2 switch to the momentary (up position) until START-UP CONTROLLER VT-13 indicator is energized	START-UP CONTROLLER VT-13 indicator on	Bay 2, VIU	
	Potentiometer turns ratio	Bay 1, PCSA	_____ turns
	Circuit resistance		_____ ohms
<div style="text-align: center; border: 2px solid black; padding: 5px; width: fit-content; margin: 10px auto;">CAUTION</div> <p style="text-align: center;">Due to circuit heating effects TS-2 switch ON time should be kept to a minimum.</p>			
Increase resistance on TS-2 potentiometer in 5 ohm steps; actuate TS-2 to the momentary (up position) until START-UP CONTROLLER VT-13 indicator is deenergized	START-UP CONTROLLER VT-13 indicator off	Bay 2, VIU	
	Potentiometer turns ratio	Bay 1, PCSA	_____ turns
	Circuit resistance		_____ ohms
TS-1 and TS-2 switches to off (center position)	TS-1 and TS-2 indicators off	Bay 1, PCSA	

Table 4-1. Electrical System Functional Check Procedures (Continued)
 Issued 19 February 1965

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
<u>MALFUNCTION TESTS</u>			
On NPU operate the following: Expansion compensator switches PnS-9 and PnS-10 released	Following MAL- FUNCTION & L. V. REFL. EJECT CIR- CUIT indicators on MALF. T/M K7 (EVM-19) EXPANSION COMPEN- SATOR NO. 1 and NO. 2 indicators on Channels 27, 37 and 38 EM on	Bay 2, VIU Bay 2, VIU Bay 3, EVR	
Actuate expansion compensator switches PnS-9 and PnS-10	Following MAL- FUNCTION & L. V. REFL. EJECT CIR- CUIT indi- cators: K7 (EVM-19) on MALF. T/M off	Bay 2, VIU	

Table 4-1. Electrical System Functional Check Procedures (Continued)
Issued 19 February 1965

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
<p><u>Low Voltage Malfunction</u> <u>Test</u></p> <p>On test set operating bay 2, turn on/operate the following:</p> <p>DIGITAL VOLTMETER INPUT SELECTOR switch to position 13</p> <p>AUTO/MAN toggle switch to AUTO</p> <p>On test set recording bay 3, turn on/operate the following:</p> <p>RECORD ON switch to record (up position)</p> <p>SAMPLING RATE switch- potentiometer to STOP</p> <p>Slowly decrease unregulated voltage (dual-output power supply) until low-voltage drop-out point is reached</p>	EXPANSION COMPEN- SATOR NO. 1 and NO. 2 indicators off	Bay 2, VIU	
	Channel 27 EM on	Bay 3, EVR	
	Channels 37 and 38 EM off	Bay 3, EVR	

Table 4-1. Electrical System Functional Check Procedures (Continued)

Issued 19 February 1965

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
Specified limits 22.5 to 23.0 volts	CIRCUIT indi- cators on:		
	SW-5A, SW-5B K7 (EVM-19) and MALF. T/M		
	Record drop- out voltage SW-5A	Bay 3, DVM	___ volts
	Channels 16, 27 and 97 EM on	Bay 3, EVR	
	CONVERTER CONTINUITY KI7 OPERATE indicator on	Bay 2, VIU	
	ESD ON indicator on	Bay 1, PCSA	
NOTE			
Do not permit ESD timer to complete its interval.			
On dual-output power supply slowly increase voltage to 28.3 $\pm$ 0.05 VDC	Record pull-in voltage	Bay 3, DVM	___ volts
	Channels 16, 27, and 97 EM off	Bay 3, EVR	

Table 4-1. Electrical System Functional Check Procedures (Continued)
Issued 19 February 1965

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
Specified limits 24.0 to 24.5 volts	Following MALFUNC- TION & L. V. REFL. EJECT CIRCUIT indicators off SW-5A, SW-5B, K7 (EVM-19) and MALF. T/M	Bay 2, VIU	
	CONVERTER CONTINUITY K17 OPERATE indicator off	Bay 2, VIU	
	ESD ON indi- cator off	Bay 1, PCSA	
On test set operating bay 2, turn on/operate the following: DIGITAL VOLTMETER INPUT SELECTOR switch to position 14			
Slowly decrease unregulated voltage (dual-output power supply) until voltage drop- out point is reached	Digital recorder will print drop- out voltage SW-5B	Bay 3, digital recorder	
Specified limits 22.5 to 23.0 volts	Record time interval from K17 OPERATE on to K5 OPERATE (ESD	Bay 2, VIU	

Table 4-1. Electrical System Functional Check Procedures (Continued)

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
<p>time); record time to monitor ELD time</p> <p>MALFUNCTION & L. V. REFL. EJECT CIRCUIT REFL. EJT. ACT. indicator on</p> <p>Channel 5 EM on</p> <p>Slowly increase voltage to 28.3 ± 0.05 VDC</p> <p>Specified limits 24.0 to 24.5 volts</p> <p>On test set recording bay 3, turn on/operate the following:</p> <p>SAMPLING RATE switch-potentiometer on</p> <p>RECORD ON switch to standby operation (center position)</p> <p>On test set operating bay 2, operate the following:</p> <p>AUTO/MAN toggle switch to MAN</p>	<p>Digital recorder will print pull-in voltage SW-5B</p>	<p>Bay 2, VIU</p> <p>Bay 3, EVR</p> <p>Bay 3, digital recorder</p> <p>Bay 3, DVM</p> <p>Bay 3, digital recorder</p> <p>Bay 2, VIU</p>	<p>_____ volts</p>

Table 4-1. Electrical System Functional Check Procedures (Continued)

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
<u>CONVERTER DEGRADATION</u>			
On test set operating bay 2, turn on/operate the following:			
DIGITAL VOLTMETER INPUT SELECTOR switch to position 17	Record voltage	Bay 3, DVM	_____ volts
VEHICLE COMMANDS CONV IMPED. TEST ON pushbutton switch	EVENT MARKERS EVM-20 indicator on	Bay 2, VIU	
	Record voltage	Bay 3, DVM	_____ volts
VEHICLE COMMAND CONV IMPED TEST OFF pushbutton switch	EVENT MARKERS EVM-20 indicator off	Bay 2, VIU	
<u>CONVERTER CONTINUITY</u>			
On test set operating bay 2, operate the following:			
CONVERTER CONTINUITY selector switch thru positions 1 to 16	CONVERTER CONTINUITY 1 thru 16 indicators on	Bay 2, VIU	
<u>ESD/ELD CHECKOUT AND RESPONSE</u>			
On test set operating bay 1, turn on/operate the following:			
COMMANDS ENERGIZE ESD pushbutton switch		Bay 1, PCSA	

Table 4-1. Electrical System Functional Check Procedures (Continued)

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
After one hour operation of ELD timer	Record time from K5 operate to K13 operate		___minutes
	RELAY POSI- TION K13 OPERATE indicator on	Bay 1, PCSA	
	MAL- FUNCTION & L.V. REFL. EJECT CIR- CUIT-REFL. EJT. ACT. indicator on	Bay 2, VIU	
	EVENT MARKERS EVM-17 indicator on	Bay 2, VIU	
	Channel 35 EM on	Bay 3, EVR	
	Channel 99 EM off	Bay 3, EVR	
On test set operating bay 1, turn on/operate the following:	RELAY POSI- TION K13 RESET indicator on	Bay 1, PCSA	

Table 4-1. Electrical System Functional Check Procedures (Continued)

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
ELD RESET pushbutton switch; RELAY RESET CONTROL pushbutton switch (1, 2, 4, 5, 12, 13) and ESD RESET pushbutton switch	RELAY POSITION K13 RESET indicator on	Bay 1, PCSA	
	MALFUNCTION & L.V. REFL EJECT CIRCUIT-REFL. EJT. ACT. indicator off	Bay 2, VIU	
	EVENT MARKERS EVM-17 indicator off	Bay 2, VIU	
	Channel 99 EM on	Bay 3, EVR	
	Channel 35 EM off	Bay 3, EVR	
NOTE			
ELD timer must be reset before the ESD timer is reset.			
On test set operating bay 2, turn on/operate the following: VEHICLE COMMANDS AC 3 pushbutton switch	EVENT MARKERS EVM-17 indicator on	Bay 2, VIU	

Table 4-1. Electrical System Functional Check Procedures (Continued)
 Issued 19 February 1965

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
<u>THERMOCOUPLE TEST</u>	Channels 35 and 98 EM on	Bay 3, EVR	
	Channel 99 EM off	Bay 3, EVR	
	RELAY POSI- TION K13 OPERATE indicator on	Bay 1, PCSA	
NOTE			
RECORD time and temperature of NPU instrumentation com- partment. Allow T/C reference junction to stabilize (heater indicator will cycle on and off prior to recording data).			
On test set operating bay 2, turn on/operate the following:			
DIGITAL VOLTMETER INPUT SELECTOR switch to position 1	T/C selector switch indi- cator on	Bay 2, tem- perature sensor panel	
T/C selector switch thru positions 1 to 48 and print record	Digital recorder print-out	Bay 3, digital recorder	
<u>RTD TEST</u>			
On test set operating bay 2, turn on/operate the following:			
DIGITAL VOLTMETER INPUT SELECTOR switch to position 2	RTD selector switch indi- cator on	Bay 2, tem- perature sensor panel	
RTD selector switch thru positions 1 to 18 and print record	Digital recorder print-out	Bay 3, digital recorder	

Table 4-1. Electrical System Functional Check Procedures (Continued)
Issued 19 February 1965

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
<u>FINAL CHECK AND RESET OPERATION</u>			
On test set operating bay 2, turn on/operate the following: DIGITAL VOLTMETER INPUT SELECTOR switch thru positions 1 to 20 and print record	Digital re- corder print-out Time of test	Bay 3, digital recorder	— hour
NOTE			
End of functional check occurs when control drums are actuated to the full-in-position and are reset to the full- out position.			
On test set operating bay 2, turn on/operate the following: e. g. DRUM DRIVE direction switch to FORWARD position		Bay 2, test drum drive assembly	
NOTE			
Procedures applicable for test drum drive assembly will be included herein when available.			
<u>RESET OPERATION</u>			
On test set operating bay 1, re- set all relays by depressing all RELAY RESET CONTROL push- button switches	ALL RESET indicator on	Bay 1, PCSA	

Table 4-1. Electrical System Functional Check Procedures (Continued)
 Issued 19 February 1965

OPERATION	INDICATION/ RESPONSE	BAY SUBASSEMBLY	RESULTS
On test set operating bay 2, depress the following RESET pushbutton switches: RESET C1-C4 RESET C5-12 RESET C13-C16	ALL SQUIB indica- tors off	Bay 2, SCA	
<p style="text-align: center;">NOTE</p> <p>Secure Electrical System Test Set TSM-2A and disconnect test cables from NPU Repeat unpowered relay status check as described in paragraphs 4-77 through 4-80.</p>			

Table 4-1. Electrical System Functional Check Procedures (Continued)

SECTION V

NPU SYSTEM REASSEMBLY

5-1. GENERAL.

5-2. NPU system reassembly operations are initiated upon completion of system and component testing. Procedures presented herein relate to reassembly operations performed in the SPTF. Deviations, including modifications, encountered during reassembly operations will be reviewed and resolved by the Test Conductor. He also assumes responsibility for generation and incorporation of authorized change procedures to this document and corresponding portions of the NPU Verification Log.

5-3. REASSEMBLY OPERATIONS. These include integration of the reflector assembly and NPU system, followed by mounting of the Agena mating ring. The ejectable heat shields are subsequently mounted to check the fit and installation. The shields are subsequently removed and packaged for shipment to the launch pad. The flow sequence for reassembly operations is illustrated in Figure 5-1.

5-4. NPU SYSTEM STATUS. Reassembly operations are performed with the NPU assembly mounted on the vertical support stand. Reference and functional testing operations are completed and the results evaluated. Reflector assembly make-ready operations are completed and preparations for installing the reflector have been completed.

5-5. REFLECTOR ASSEMBLY INSTALLATION PROCEDURES.

5-6. PURPOSE AND SCOPE. The purpose of this operation is to prepare and subsequently install the reflector assembly on the NPU, replacing the shipping sleeve with the reflector assembly. Procedures include both preparation and installation of the reflector assembly.

5-7. EQUIPMENT REQUIREMENTS. Equipment required for these operations include the following:

- a. Reflector assembly installation fixture.
- b. Void filler blocks.

Figure 5-1. NPU System Reassembly Sequence - SPTF

- c. Key-lock barrels.
- d. TABRD and EABRD assemblies, and associated hardware.

5-8. REWORKING REFLECTOR ASSEMBLY PIN PULLERS. In preparing the reflector assembly for installation, rework each of the flight system pin pullers according to the following steps.

- a. Remove the dummy squibs from the flight system pin pullers. Package for return to AI headquarters facilities.
- b. Inspect related portion of reflector for evidence of dirt or foreign material.
- c. Verify that piston is in proper position. If piston has moved back as evidenced by a sheared lockwire, disassemble as follows:
 - 1. Remove shear wire.
 - 2. Remove collet and piston.
 - 3. Inspect interior and related parts.
 - 4. Clean with alcohol and/or acetone and dry.

NOTE

White gloves must be worn while performing the following operations.

- 5. Reassemble collet, spring, and piston. Lockwire the assembly.
- d. Depress the pin and check collet to make certain it is engaged.
- e. Replace lockwire as illustrated in Figure 5-2.

Figure 5-2. Lockwire Installation

5-9. REFLECTOR ASSEMBLY PREPARATION. Prepare the reflector assembly for installation by completing the following operations.

- a. Remove checkout and tooling fixtures used for reference and functional tests.
 1. Disconnect cabling.
 2. Lockwire the snap-in springs and stepper motors.
 3. Remove reflector halves from core simulation fixture; place on workbench.
 4. Install key-lock barrels.
- b. Verify tool and part accountability.

5-10. Tooling Unit Pin Puller Installation.

5-11. Install dummy squib pin pullers (tooling units) as follows:

- a. Verify orientation of dummy squibs in the tooling units, i. e., key location in conjunction with the wiring harness connector key slots. If these do not correspond, proceed as follows:
 1. Remove dummy squibs.
 2. Shim and retorque as necessary so keyways in the squibs line up within plus or minus 45 degrees of the wiring harness connector.
 3. Make maps of these orientations as related to the four positions involved.
 4. Identify each map and retain for further reference.
- b. Install the tooling units using short internal wrenching cap screws which have been molykoted.

NOTE

The head of these cap screws has been painted red for purpose of identification.

- c. Attach wiring harness connectors to the tooling unit dummy squibs.
- d. Lower the antivibration latches and torque the retaining nuts.
- e. Replace all keylock barrels.
- f. Repeat steps a through e for each of the remaining tooling unit pin pullers.
- g. Verify tool and part accountability.

5-12. Reflector Assembly and Reactor Vessel Inspection.

5-13. Inspect the entire reflector assembly and reactor vessel exterior for evidence of dirt or extraneous materials in accordance with the NPU Verification Log checklist.

5-14. Lockwire Inspection.

5-15. Inspect all reflector assembly lockwiring for integrity and proper orientation in accordance with the NPU Verification Log checklist. Verify proper position of the sensor shear wire and set screws.

5-16. Inspection of Surface Coatings.

5-17. Inspect all reflector assembly surface coatings in accordance with the NPU Verification Log checklist. Coatings should be clean and smooth without evidence of chipping or cracking.

5-18. Inspection of Electrical Components.

5-19. Inspect all reflector assembly electrical components for proper installation and general condition as follows:

- a. Check limit switch installation and condition.
- b. Verify integrity of EABRD and T/C junctions.
- c. Verify satisfactory condition of wiring harness connectors.
- d. Check circuit resistance and insulation resistance of EABRD isolation strip. Verify acceptability by comparison with previous measured values.
- e. Inspect EABRD for evidence of damage to connecting pin holes and terminal lugs.
- f. Clean EABRD parts with alcohol and/or acetone and dry. Store for subsequent installation.

5-20. Void Filler Block Installation.

5-21. Install the void filler blocks, following the sequence given in subsequent steps.

- a. Install void filler blocks in fine control drum No. 2 (+Z location) as follows:
 1. Place one small cavity block in the drum cavity.
 2. Place one large cavity block on top of small block.

3. Mount small unit face block to unit with the two bolts; tighten bolts finger tight.
 4. Attach small unit face block to small cavity block and secure with two self-locking screws; tighten finger tight.
 5. Attach small unit face block to large cavity block and secure with two self-locking screws; tighten finger tight.
 6. Torque the two bolts on the unit face flock and the four bolts on the filler blocks, in that order, to 90 in-lb each.
 7. Inspect the filler block installation, verifying accountability of parts and tools.
- b. Install void filler blocks in coarse control drum No. 3 (+Z location) as follows:
1. Place one large cavity block in the drum cavity.
 2. Place one small cavity block on top of large cavity block.
 3. Mount large unit face block to unit, using two bolts with lockwashers; tighten finger tight.
 4. Attach large unit face block to large cavity block and secure with two self-locking screws; tighten finger tight.
 5. Attach large unit face block to small cavity block and secure with two self-locking screws; tighten finger tight.
 6. Torque the two bolts on the unit face block and the four bolts on the void filler blocks, in that order, to 90 in-lb torque.
 7. Inspect the filler block installation, verifying accountability of parts and tools.
- c. Install the void filler blocks in coarse control drum No. 1 (-Z location) by repeating the sequence of operations listed under step a, items 1 through 7.
- d. Install the void filler blocks in fine control drum No. 4 (-Z location) by repeating the sequence of operations listed under step b, items 1 through 7.

NOTE

Spacer requirements are determined during original installation. This information is available with filler block assembly records originated at the Santa Susanna facility.

5-22. REFLECTOR ASSEMBLY INSTALLATION. The following equipment is required for reflector installation:

1. Reflector assembly installation fixture and sling.
2. Reflector assembly handling fixture and sling.
3. Ejection spring compression fixture.
4. Special clamps used to hold reflector halves during retainer band installation.
5. Transfer lock and keys (for installation fixture).
6. Hydra-Set (installed on overhead crane hook).
7. Reflector installation tools (special tools).

5-23. Preliminary Procedures.

5-24. Verify that the following precautions are observed and in effect prior to initiating reflector installation operations.

- a. Verify that reflector control drums are locked in out position.
- b. Verify that drum lock keys have been returned to Test Conductor.
- c. Verify that the drop protector is available at the work station.

NOTE

White gloves shall be worn when handling and working with the reflector assembly. Ascertain that gloves are available for use.

5-25. Shipping Sleeve Removal.

- a. Attach reflector assembly handling sling to one-half of the reflector assembly.
- b. Using the overhead hoist and Hydra-Set for initial few inches of raising and final few inches of lowering of reflector assembly half, pick up reflector assembly half and place on reflector assembly installation fixture.

NOTE

Place the reflector assembly half with small hinge on the right side on carriage "A" side (-Z side) of reflector installation fixture.

- c. Attach reflector assembly half to carriage using the retainer bolts (ball lock pins) which attach to the void filler blocks. Remove reflector handling sling from reflector half.
- d. Repeat steps a, b, and c for the opposite reflector half.
- e. Replace reflector assembly handling sling on Hydra-Set with reflector installation fixture sling.
- f. Attach reflector installation fixture sling to reflector installation fixture by attaching at the pickup points on installation fixture.
- g. Using Hydra-Set, hoist reflector installation fixture (with reflector halves in place) to top of NPU work stand, positioning fixture over the reactor.

NOTE

Orient the reflector assembly installation fixture in line with the Z axis of the NPU. Also, the reflector assembly half that is installed on the +Z axis will have the large lower hinge on the right side of the +Z axis (toward -Y axis) when facing the reactor core. This half is installed on the "B" dolly. Place the "A" dolly on the -Z side of reactor.

5-26. Reflector Installation.

5-27. The following procedure shall be followed for installation of the reflector assembly and removal of the shipping sleeve:

- a. Obtain key for carriage "A" of reflector installation fixture from transfer lock and unlock carriage "A" drive.

NOTE

Keys are the responsibility of, and are retained by, the Mechanical Engineer.

- b. Move carriage "A" into position for attaching to shipping sleeve by rotating crank on end of dolly corresponding to the "A" carriage (white color-coded).
- c. Align attach pins to sleeve by adjusting the vertical positioning adjustments for sleeve (yellow color coded) crank and carriage drive crank (white color coded).
- d. Insert attach pins into sleeve and adjust tilt of the sleeve using the tilt adjustment (located on collar below carriage).

- e. Place preload on fixture by rotating vertical positioning adjustment (yellow color-coded) clockwise.
- f. Lock carriage "A" drive by removing key and place carriage "A" key back in transfer lock.
- g. Remove carriage "B" key from transfer lock and unlock carriage "B" drive.
- h. Move carriage "B" into position for attaching to sleeve by rotating crank on end of dolly corresponding to "B" carriage.
- i. Align attach pins to sleeve by adjusting the vertical positioning adjustment for sleeve (yellow color-coded) and carriage "B" drive wheel (white color-coded).
- j. Insert attach pins into sleeve and adjust the tilt of the sleeve using the tilt adjustment (located on collar below carriage).
- k. Place preload on fixture by rotating vertical positioning adjustments (yellow-color coded) clockwise.
- l. Release lower adjustable clamps on sleeve by loosening Allen-head screws on each clamp (4).
- m. Unlock sleeve clamping attachment on sides of sleeve.
- n. Move sleeve half away from core vessel by rotating carriage "B" crank at end of installation fixture (white color-coded).
- o. Install the two reflector ejection springs and cups and compress springs using two ejection spring compressor fixtures.
- p. Remove reflector assembly lower hinge pins from core vessel.

NOTE

Place catch pans under reflector hinge pins before removing or installing pins.

- q. Rotate reflector half on carriage "B" 180 degrees to the IN position or facing the core vessel by turning carriage turret rotation crank on side of installation fixture (blue color-coded).

CAUTION

Raise reflector half to maximum adjustment by rotating vertical positioning adjustment counterclockwise to ensure that reflector assembly hardware (microswitches, cables, etc.) will clear the reflector installation fixture before rotating turret.

- r. Move reflector assembly half into position around core vessel by rotating carriage "B" drive wheel at end of fixture (white color-coded).
- s. Align reflector assembly half by adjusting reflector vertical positioning adjustment (red color-coded), tilt adjustment, and horizontal positioning adjustment.

NOTE

Reflector half has a back tilt of $5 \pm 1^\circ$ when being aligned with core.

- t. Install reflector assembly lower hinge pins.
- u. Remove reflector half ball-lock pins and allow reflector to come against top reflector stops.
- v. Lock carriage "B" drive by removing key from lock and place key back in transfer lock.
- w. Remove carriage "A" key from transfer lock and unlock carriage "A" drive at end of fixture.
- x. Repeat steps n through u for carriage "A".

5-28. Accelerometer Installation.

- a. Mount block on upper torque ring at -Y axis. (Use NAS 501H4-A14 bolt.)
- b. Clean insulation on transducer receptacles and cable connectors.

CAUTION

Use pure ethyl alcohol and paper wipes. Allow connectors to dry thoroughly before mating. Exercise care to avoid damage to connectors.

- c. Mate cables to transducers; verify connections.
- d. Install cable clamp using: 1 ea of following: An742H4, NAS1101C3H4, MS20995N32 and A/R Vargla Sleeving No. 1 lockwire; check installation.

5-29. TABRD Installation.

- a. Install special clamps to hold reflector halves together.
- b. Remove pins (ball-lock) connecting installation fixture to reflector on +Z side.
- c. Remove void filler blocks on +Z side, per verification log checklist.
- d. If aluminum "Tee" spacers are not already installed, prepare short and long band sections for installation by using spring compressor pliers to open band tension springs sufficiently to allow the placement of "Tee" spacers between spring and spring support. This releases the tension from band during installation.

WARNING

Wear safety glasses when installing or removing restraining band in case of accidental release.

- e. Lay out bands end to end, aligning bolt holes of bands (short band at bottom). Place two washers at the bottom of the band and one on top. Insert bolt.
- f. Place this assembly around reflectors with bolt inserted in the temperature-activated band release device (TABRD).
- g. Place long band section into recessed receiver support brackets and stand-offs.
- h. Secure end of band to reflector with plastic tie-wrap.
- i. Tighten bolt with Allen wrench until bands are snug but just free enough to pivot about bolt.

5-30. Retaining Band and EABRD Installation.

NOTE

The retaining band is provided as two subassemblies, each of which has a compression spring. The EABRD is temporarily secured to the +Z reflector half.

- a. If a tooling band is in place but no toggle clamps are installed proceed as follows: Remove the safety cables, one side at a time, and replace each with a toggle clamp. When both clamps are in place, check spring depressor tool and depress springs, if needed, then remove tooling band.
- b. Check spring depressors for proper compression and remove tooling band.

c. Prepare the link sections for installation. Using toggle pliers, compress band tension springs sufficiently to allow placement of the "Tee" spacers between spring and spring support. This releases the tension from the band while it is being installed. This need be done only once if "Tee" is installed each time prior to band removal.

d. Untie the EABRD and attach it to the yoke end of the small band section using clevis pin. The head of the clevis pin shall be toward the reflector when the band is installed. Secure the pin with the cotter pin.

e. Attach the other end of the small band section to band fitting at the TABRD using the threaded pin with the head toward the reflector. This band section starts at the +Y axis and extends counterclockwise to the +Z axis in the properly installed position. Secure the pin with the nut. Do not allow the band section to hang on the EABRD electrical wire. Temporarily secure the EABRD and band to the stepper motor with lockwire.

f. Attach the long band section to the other band fitting at the TABRD using the threaded pin, with the head toward the reflector. This band section starts at the +Y axis and extends clockwise to the +Z axis in the properly installed position. Secure the pin with the nut.

g. Place the long band section into the grooves in the brackets and standoffs. Place the loose end into the slot in one arm of the band-installation tool.

h. Place the short band section into the grooves in the brackets and the loose end into the other side of the tool. The tool will straddle the EABRD and will support the band sections when properly installed.

i. Place graphite-foil strips under band at support-bracket and standoff locations. The installation of graphite-foil must take place before tension is placed on band assembly. This is best done as follows:

1. Start tightening band while holding band parts in guides. Proceed slowly and tighten band-assembly tool by turning spindle. When band starts to snug down check band alignment with the groove in bearing blocks and stand-offs. Make sure all except one of these are aligned and in place. This misaligned spot is the place to start the graphite foil insertion.
2. To insert the graphite foil for the band, the band must be slipped down on the guide lip about 0.050 in. This can be done with a screwdriver, thus providing a slot into which the graphite foil can be slipped. When the graphite foil is in place, the band is raised and by the use of a screwdriver and the next bearing point is slipped down, etc., proceeding

around the assembly. The insertion removes some of the slack and periodically the band must be loosened to provide enough slack.

j. When all foil is in place, retighten band assembly tool and align EABRD with clevis hole. Vibrate if necessary.

CAUTION

If band is tight and stiff, the springs can be inadvertently compressed well beyond the maximum limit of 185 lb. This must be avoided and at least 0.030 in. of clearance left in visible part of spring at all times. If this happens, obtain vibrator and vibrate while tightening. At no time permit spring tension to exceed the 185 lb limit. Later vibration is still required.

The band-assembly tool is provided with a screw stand-off which can be adjusted to provide clearance for the introduction of a pin-insertion tool while holding the EABRD pin. Insert pin and secure cotter key. Relax assembly tool and remove. Inspect foil installation.

k. If necessary, use toggle pliers to open band tension-springs sufficiently to allow removal of "Tee" spacers. Remove spacers. This places a 165 to 185-pound tension on the band.

l. Complete tightening of bolts at TABRD using special wrench, 3/6-in. box wrench and 1/16 Allen wrench.

m. Clamp vibrator on band-assembly and vibrate system for approximately 2 minutes.

n. Check precalibration lines on the spring housing. The spring disc should locate between the extreme limits marked on band spring. Estimate tension to nearest 5 pounds, and record value.

NOTE

The center-line position represents 165 lb. Lines on each side of center represent ± 15 lb.

o. Install safety cables as follows:

1. Remove one toggle clamp.
2. Pull keepers and pins and install cable reinstall pins and keepers using keeper installation tool.
3. Repeat for other side.

- p. Install graphite foil and remove spring depressor tool as follows:
1. Carefully place one graphite foil washer on top of each spring. If necessary, depress spring further using spring compressing tool. Carefully relax tool permitting spring to rise and hold the graphite foil washer between the spring adapter and the plates on the bottom of the reactor. Release spring depressor tool placing ejection spring pressure on reflector assembly. Remove and store spring depressor tools.
 2. Check and record band tension to nearest 5 pounds.
 3. Make visual inspection of reflector units to assure proper positioning of reflector halves with respect to reactor vessel.

5-31. Reflector Installation Inspection.

- a. Check installation and precalibration lines on band tension spring and spring disc.

NOTE

End of spring should line up with inscribed line on spring housing. This will ensure 165 pounds tension. If the spring does not line up correctly, recheck band at stand-offs and support brackets.

- b. Install reflector restraining cable assembly and band release fusible safety link.
- c. Remove clamp tool.
- d. Remove the two special clamps holding reflector halves together.
- e. Reinstall void filler blocks, per verification log checklist.
- f. Release reflector ejection springs by removing the four spring compressor assembly fixtures.
- g. Check that the reflector assembly is resting securely against reflector stop brackets at top of reactor core.

NOTE

If the reflector is properly installed, clearance between the reflector and stops will be less than 0.0015 inch. Adjustments shall be made if the fit is not correct.

h. Release the ball-lock pins (one on each half) attaching the reflector assembly installation fixture to the void filler blocks on the reflector assembly.

5-32. Installation Fixture Removal.

a. Obtain carriage "A" key from transfer lock, unlock carriage drive, and move carriage "A" back using carriage drive (white color-coded) from reflector assembly to the full out position on reflector installation fixture.

b. Lock carriage "A" by removing key and place key back in transfer lock.

c. Repeat steps g and h (par. 5-30) for carriage "B".

d. Install reflector installation fixture handling sling on Hydra-set (Hydra-set attached to overhead hoist or crane) and attach sling to reflector assembly installation fixture.

5-33. TABRD INSPECTION. Upon completion of reflector installation, perform the following inspection:

a. Remove tooling band if installed. Remove a sufficient number of cable clamps holding wiring harness to TABRD to permit complete inspection of latter. Spread wiring harness cables wide enough to be able to work on both ends of the TABRD.

b. Remove bottom shroud-bolt and tantalum cover.

c. Install tool SE 6000850 and adjust it to hold the inner rod to its highest position.

d. Insert a long, fine, slot-type screwdriver down into the slot in the end of the stud.

e. Holding the screwdriver steady (and hence the stud), unscrew the nut with torque wrench. Remove it and the screwdriver from the stud.

f. Remove spacer, the upper band fitting, the lower band fitting and the two Grafoil washers.

g. Discard Grafoil washers and return the lower band fitting to the AI headquarters Control Station, Dept. 789, for inspection and rework.

h. Using a flashlight and special straight-edge, check stud for straightness at four positions around its circumference. If any light shows between straightedge and stud, the latter shall be replaced.

i. Reassemble TABRD with new Grafoil washers, a new lower band fitting, the old upper band fitting, and the old spacer.

j. Slipping the activating nut over the blade of the screwdriver, put the screwdriver into the slot in the stud.

k. Holding the screwdriver steady so as not to transmit any torque through the notched section of the stud, tighten the activating nut to a torque of 15 in./lb over nut friction.

CAUTION

Take care not to subject the stud to bending during this assembly.

l. Remove the locating tool; check to be sure the TABRD is still cocked, and reassemble the covers and cables. Reinstall tooling band if next operation is not to proceed immediately.

5-34. REFLECTOR INSTALLATION CLEARANCE CHECK. Check vessel-to-reflector clearances as follows:

a. Measure and record the clearances between the fixed hinges and the vessel bushings. (Terminology is based on the observer facing the hinges.)

b. Measure and record minimum clearances between the floating hinges and vessel brackets. (Terminology is based on observer facing the hinges.) The position of minimum clearance is also to be approximately determined.

c. Measure and record clearances between hex head adjusting bolts and bracket at top of reflector. (Terminology based on observer facing and looking down at reactor at Y stations.)

d. Measure and record clearances between dome head adjusting pin and reflector bracket. (Terminology is based on observer facing and looking down at reactor at Y stations.)

e. Check all lockwiring for proper installation and integrity.

5-35. AGENA MATING RING INSTALLATION PROCEDURE.

5-36. The purpose of this procedure is to ensure proper fit of the Agena mating ring prior to delivery of the NPU to the launch pad. Installation of the mating ring completes the flight-ready configuration of the NPU except for the ejectable heat shields. The installation will be performed by LMSC personnel in accordance with LMSC specification No. 1417300. AI personnel will handle the NPU for required positioning.

5-37. EQUIPMENT REQUIREMENTS. The following equipment will be required to position the NPU for mating ring installation and final match-mate of the NPU to the payload adapter.

- a. NPU Handling Fixture
- b. NPU Vertical Handling Fixture Sling
- c. Hydra-Set
- d. Hydra-Set Control Console
- e. Overhead Crane.
- f. Mating ring and associated materials (supplied by LMSC).

5-38. INSTALLATION PROCEDURE. The NPU Mating Ring, prepared in accordance with LMSC Specification No. 1417300 is installed on the NPU. The NPU will be in its handling fixture and mounted on the NPU Vertical Support Stand. Proceed as follows:

NOTE

Ensure that three technicians and an LMSC representative are available for installing the mating ring.

- a. Connect the Hydra-Set to the overhead crane.
- b. Connect the Hydra-Set Control Console to the Hydra-Set.
- c. Connect the Handling Fixture Vertical Sling to the Hydra-Set.
- d. Using the overhead crane, position the sling for attachment to the handling fixture and connect the sling to the fixture.
- e. Using the Hydra-Set and then the overhead crane, hoist the NPU and position it overhead so that the index pin hole in the NPU lower support leg (+Y axis quad 1) is in line with the respective index pin on the payload adapter ring. Inspect the mating surfaces of the eight mounting pads to ensure freedom of scratches, dirt, or other defects detrimental to proper mating.
- f. Lower the NPU using the overload crane and Hydra-Set. At each of the eight mounting pads, inspect for bearing surface contact between the AI lower support base (10FSM1-61016) and the LMSC diffusion barrier (1359240). This check is made with just the "static" weight of the NPU on the adapter assembly. Using feeler gauge measurements, determine that there is bearing contact at all eight mounting pads. Bearing contact limit is defined as zero to 0.003 inches of clearance.

g. If shimming is required to meet the bearing contact requirements at any of the eight mounting pads, use the shims provided (1368807-1). Peel shim as required to correct thickness to meet above requirements. "Step" peeling of shim, either lengthwise or widthwise, is suggested if any of the mounting base pads are out of plane with respect to the diffusion barrier.

h. Insert the sixteen LS8762-4-10 screws through the tunnels in the NPU lower support bases and into the payload adapter assembly to verify physical compatibility of the two units. Upon verification, remove screws and stow until final match-mate phase.

i. Using the Hydra-Set and overhead crane, raise the NPU clear of the payload adapter assembly and bond shims to the diffusion barrier portion of the adapter as required. Removal of the DOW-17 coating is not necessary. Use a very thin coating of the adhesive as bond strength is not the governing criteria. Bonding to be per spec. LAC-3013. The cure shall be at room temperature only.

j. Coat forward face of the diffusion barrier portion of the payload adapter assembly (1359240) 0.75 inch wide circular strip with high vacuum silicone grease (Dow Corning) approximately 0.03 ± 0.01 thick.

k. To provide protection against electrolytic corrosion between the titanium mounting pads and the aluminum shims and magnesium diffusion barrier, apply a thin coat of high temperature adhesive, LAC-30-4110, to each of the eight NPU lower support bases (10FSM1-61016) per PB-39.

l. Using the overhead crane and Hydra-Set gently lower the NPU keeping the index pin hole (+Y axis, quad 1) in line with the index pin until contact is made with the payload adapter assembly at the eight NPU lower support bases.

m. Insert the sixteen LS8762-4-10 screws through the NPU lower support bases and the payload adapter assembly after lubricating threads with dry film lubricant (type I, air dry) per spec LAC-0515.

n. Install the sixteen NAS1197-416L washers and LS8859-4 nuts after lubricating threads with dry film lubricant (type I, air dry) per spec LAC-0515. Seat the nuts against the payload adapter assembly fittings by torquing in a criss-cross pattern using a maximum torque of 30 ± 10 inch pounds above friction torque. Friction torque is the torque required for full engagement of the nut on the threads.

o. After seating all sixteen nuts per paragraph n, repeat the procedure until a total of 60 ± 10 inch pounds has been applied to each of the sixteen LS8859-4 nuts. This 60 ± 10 inch pounds being in addition to that required to overcome friction torque.

p. Torque paint all sixteen screw protrusion/nut combinations with pink marking lacquer or equivalent.

q. Verify that the paint has been removed from the forward face of the NPU instrument compartment in the four bonding strap locations as shown on LMSC drawing 1339700 section P-P and view E-E and install the four 136230-1 bonding straps per AI spec NA0113-007. Remove excess grease in the area of the straps.

r. Install the remaining 60 screws, washers, and nuts attaching the NPU instrument compartment to the diffusion barrier. Torque all nuts to 25-40 inch pounds on the NPU side.

s. Remove all excess grease on both sides of the faying surfaces by hand-wiping with one or more of the suitable solvents listed in spec LAC-0170, paragraph 3.1. Mechanical match-mate is now complete.

t. Verify that no portion of the primary payload encroaches into the diffusion barrier vent valve stay-out area as shown on AI drawing 10FS-60001, "SNAP 10A Control Drawing Flight System" and LMSC drawing 1339724 "Interface - Payload, LMSC/AI." Stay out area is located in quad 1, $8^{\circ}26'$ off the +Y axis.

5-39. EJECTABLE HEAT SHIELD INSTALLATION PROCEDURE.

5-40. PURPOSE. The purpose of the trial installation of the ejectable heat shields is to verify that the shields fit properly and have not been warped in handling and transit. Trial installation ensures that the heat shield status is acceptable for installation at the launch pad.

5-41. EQUIPMENT REQUIREMENTS. The overhead crane, Hydra-Set and NPU handling fixture sling are used in readying the NPU for heat shield installation. Aside from the hardware used in heat shield installation, no special equipment is required.

5-42. INSTALLATION PROCEDURE. Prepare the NPU for heat shield installation; mount the shields for trial installation check as follows:

a. Unbolt the NPU handling fixture from the handling fixture feet.

b. Using the overhead crane hoist and Hydra-Set, carefully lift the handling fixture from the NPU.

- c. Move the handling fixture clear of the NPU work area and lower it to the floor for temporary storage.
- d. Verify availability of heat shield installation hardware and heat shields.

CAUTION

Provide adequate support for the heat shields during handling and installation operations, to prevent shield damage.

- e. Remove the spring and plunger from the heat shield thrust tube ejection cylinder.
- f. Replace the nut on the thrust tube to the exact previous position.
- g. Check the pivot arm shaft and pivot block for cleanliness.
- h. Mate the pivot arm with the pivot block and electrical plug on the NPU, while supporting the heat shield.
- i. Rotate the shield into position so that lower guide pins enter slots.

CAUTION

Use care in aligning the pivot arm with the pivot block, as sidewise clearance on the alignment screws is only 0.005 inch.

- j. Verify proper mating of heat shield edges and alignment with the NPU.

CAUTION

Check clearances and fit of heat shield in accordance with specifications outlined in the NPU Verification Log.

- k. Holding the shield halves together at the top, adjust the thrust tube nut to contact the bracket. Mark the location of the nut.
- l. Verify the rotation and release of each shield and pivot.
- m. Re-install the thrust tube spring and plunger.
- n. Re-install the thrust tube nut to the location as marked in step k.
- o. Safety wire the thrust tube nut to prevent rotation.
- p. Install the four plunger retainers on the thrust tube nut.

- q. Remount the heat shields on the pivots, and check to verify that the shields remain centered.
- r. Tighten and safety wire the adjusting locknuts.
- s. Fit and adjust the pin puller for a free fit in the heat shield bushing.
- t. Install the squib simulators in the pin puller.
- u. Resafety wire the screws in the pin puller brackets if adjustment was required in step s.
- v. Insert the heat shield band ends in the band guide.
- w. Assemble the band turnbuckle and tighten the turnbuckle just enough to remove all slack from the band.

CAUTION

Use an AN-315D3 nut or an acceptable substitute during adjustments to reduce wear on the turnbuckle screw. The nut furnished with the assembly will be used for the actual flight only.

- x. Remove the plunger retainers installed in step p, while holding the shield halves together.
- y. Tighten the turnbuckle nut just enough to remove all slack from the band.
- aa. Continue to tighten the turnbuckle nut until the distance between the ends of the band has been reduced approximately 0.6 inch.
- bb. Safety wire the band retainer.
- cc. Verify proper installation fit of heat shields and associated hardware.
- dd. Obtain Test Conductor approval to remove and package heat shields for shipment to PALC-2.

5-43. HEAT SHIELD REMOVAL PROCEDURE. Remove the heat shields, following the installation fit check, as follows:

- a. Verify that the heat shield shipping container has been opened in readiness for heat shield packaging.
- b. Disconnect heat shield to NPU electrical connections.
- c. Loosen and remove heat shield retaining band. Provide adequate manual support for each heat shield half as the retaining band is removed.

- d. Rotate one of the heat shield halves outward toward the eject position until the heat shield is free of the NPU. Place the shield half in the shipping container.
- e. Repeat step d for the second shield half.
- f. Place fresh desiccant in the heat shield shipping container.
- g. Using the overhead crane, with heat shield shipping container sling and Hydra-Set attached, replace the shipping container upper half, lowering into position with the Hydra-Set.
- h. Secure the shipping container halves, using the fastenings provided.

SECTION VI

NPU DELIVERY PREPARATIONS, PHASE I

6-1. GENERAL.

6-2. Upon satisfactory completion of inspection, testing and reassembly phases of NPU prelaunch operations, the NPU is packaged and stored as a complete flight-ready system until scheduled for delivery to the launch complex.

6-3. SCOPE. Delivery preparations entail preparation and packaging of the NPU and the heat shields. Preparation includes verification of NPU control relay status, converter continuity and a summary physical inspection of the NPU. The purpose of these operations is to ensure the physical and electrical integrity of the NPU system upon arrival at the launch complex.

6-4. NPU STATUS. The NPU is assembled with the reflector assembly installed and all mechanical safeguards in place and accounted for. The NPU/Agena mating ring is also installed and adequately wrapped to provide protection for the thermal coating. The NPU Handling Fixture is in place on the NPU. Ejectable heat shields are packaged in the heat shield shipping container; fresh desiccant has been inserted and the container secured for shipment.

6-5. EQUIPMENT REQUIREMENTS. Required equipment items are included in the referenced procedures which follow.

6-6. PREPACKAGING VERIFICATION CHECKS.

6-7. Preparatory operations are repetitious of those performed during prior phases of NPU prelaunch operations conducted at the SPTF. Operations to be completed prior to packaging the NPU are listed in the sequence of performance, and are referenced to similar procedures appearing elsewhere in this manual.

6-8. RELAY STATUS CHECK. Perform the relay status check presented in paragraphs 4-77 through 4-80, to ensure proper status of all latching control relays prior to packaging the NPU.

6-9. CONVERTER CONTINUITY AND RESISTANCE CHECKS. Perform the continuity and resistance checks according to the procedures presented in paragraphs 4-71 through 4-75, to ensure that converter system electrical characteristics have remained unchanged throughout prior testing operations.

6-10. NPU PHYSICAL INSPECTION. Physically inspect the NPU for evidence of possible damage incurred during prior testing operations, completing the inspection in accordance with the NPU Verification Log checklist. The purpose of this inspection is to ensure satisfactory physical status of the NPU prior to packaging.

6-11. NPU PACKAGING PROCEDURE.

6-12. Packaging of the NPU and heat shields is performed in accordance with the procedures presented in Section III of NAA-SR-MEMO 9351.

6-13. NPU SHIPPING CONTAINER PREPARATION. Prepare the shipping container per the procedure outlined in paragraphs 3-17 through 3-22.

6-14. NPU PACKAGING. Install the NPU in the shipping container, close the container and complete packaging operations per the procedures outlined in paragraphs 3-22 through 3-33.

6-15. HEAT SHIELD PACKAGING. Package the heat shield per the procedure outlined in Appendix A of NAA-SR-9351. If packaging was performed upon removal of the heat shields following trial installation, verify that container lid is securely fastened prior to loading the container.

6-16. SHIPMENT.

6-17. Shipment of the NPU and the ejectable heat shields to the launch complex will be performed in accordance with the procedures presented in Volume II of NAA-SR-MEMO 9351.

NOTE

Shipment of the NPU assembly and the ejectable heat shields will be handled on an individual basis to expedite handling.

SECTION VII
REPAIR LIMITS

7-1. GENERAL.

7-2. SPTF Operations function within the confines of a limited repair philosophy due to the nature of the system involved; i. e. structural design and nuclear reactor safeguards. Major repairs require return to Atomics International.

7-3. SCOPE OF OPERATIONS. Normal maintenance, repair and replacement capability includes provisions for control of a NaK leak, repair of minor structural damage, and replacement of electrical components. SPTF equipment to support minor repairs is available such as welding machines, leak detectors, portable hand tools, and electronic test equipment.

CAUTION

It is mandatory that cognizant supervision assure no repairs are undertaken that could alter characteristics of the NPU.

7-4. REPAIR AND/OR DAMAGE ASSESSMENT.

7-5. Assessment of damage occurring during launch operations shall be made by the Test Conductor and the assistant test conductors. Evaluation of subsequent action, including proposed repair, shall be performed by the Test Conductor and QC representative. The evaluation and related recommendations shall be presented to the Engineering Supervisor for approval of subsequent action.

7-6. In the event physical damage is incurred, extent of the damage shall be evaluated to determine the following:

- a. Seriousness of the damage and effect on the NPU system.
- b. Where and how repair may be effected.

7-7. DEFINITION OF REPAIRS. For purpose of definition, damage assessment shall be made on the following basis:

- a. Repairable at SPTF using existing equipment and personnel.
- b. Repairable at SPTF, but requiring special equipment and personnel.
- c. Non-repairable at SPTF, requiring return to AI Santa Susana facilities for repair.

7-8. Repair at the SPTF is generally restricted to the removal and replacement of existing components. The repair of these components is generally not within the capabilities of the facility. Correction of malfunctions which can not be corrected by removal or replacement of individual components shall be as directed by the Engineering Supervisor and Test Conductor. The corrective action taken shall be monitored by the QC representative to ensure maintenance of NAA quality control standards.

7-9. REPAIR PROCEDURES.

7-10. The extent of repairs which may conceivably be necessary at the SPTF cannot be anticipated. However, in the event repair is required, it may be necessary to remove and replace NPU components. These operations are performed in accordance with established procedures which are presented in the following paragraphs.

7-11. RADIATION SHIELD REMOVAL AND INSTALLATION.

7-12. NPU repair or modification requirements may necessitate removal of the radiation shield. Trained technicians shall perform this operation to prevent damage to radiation shield and inside of NPU.

7-13. PREREQUISITES. Handling equipment will be verified available and ready for use in accord with the AGE planning form. The NPU, with handling fixture removed but handling fixture feet installed, shall be mounted on the guide fixture.

7-14. PREPARATION. Proceed as follows to install the shield handling fixture to the vertical support stand:

- a. Vertically center hydraulic ram inside vertical support stand. Secure with four turnbuckles on brace assemblies.
- b. Position shield holding fixture (dish) on top of hydraulic ram.

- c. Attach hydraulic hose from hand pump on dolly to hydraulic ram.
- d. Bleed air from ram at bleed plug on second stage cylinder.

7-15. Prepare for radiation shield removal as follows:

- a. Ensure Hydra-Set is installed on overhead crane. Place vertical lifting yoke on Hydra-Set and position over the NPU.
- b. Lower vertical lifting yoke over the NPU and attach to nut plates on upper torque ring of NPU.
- c. Lift NPU onto vertical support stand, using Hydra-Set to control the first and last few inches of travel.
- d. Disconnect vertical lifting yoke from NPU.

NOTE

The vertical lifting yoke may be left in position if desired as it does not effect subsequent operations.

7-16. RADIATION SHIELD REMOVAL. Remove the radiation shield from the NPU by performing the following operations:

- a. Operate dolly-mounted hand hydraulic pump to raise ram and dish up to the radiation shield.
- b. Ensure that radiation shield is fully bottomed in hemispheric dish.
- c. Use extension wrench to loosen the eight bolts securing radiation shield to NPU, and proceed to remove the bolts.
- d. Slowly release hydraulic pressure at the hand pump, allowing the pump ram to retract fully.
- e. Reconnect vertical lifting yoke to the NPU if it has been removed.
- f. Using Hydra-Set, raise the NPU a few inches above the vertical support stand.
- g. Using the overhead crane, raise the NPU clear of the stand and radiation shield. Move it clear of the support stand and lower it to the floor or into the guide fixture for temporary storage. Use Hydra-Set to lower NPU the last few inches.
- h. Place shipping container support ring on shield assembly and secure in place.
- i. Remove vertical lifting yoke from NPU and Hydra-Set.

- j. Install the radiation shield handling sling on the Hydra-Set. Position sling above the radiation shield.
- k. Lower sling into position over the shield and attach to shield.
- l. Using the Hydra-Set, lift the radiation shield from the support dish. When clear of the dish, raise the shield above and away from the vertical support stand.

NOTE

Subsequent storage of the radiation shield depends upon the nature of NPU operations to be performed and the time involved. Procedures for temporary storage are at the discretion of the Mechanical Engineer.

7-17. Installation of Radiation Shield in Shipping Container.

7-18. To install the radiation shield in the shipping container, proceed as follows:

- a. Remove ball lock pins on shield handling fixture and rotate shield assembly 180 degrees. Secure in this position by inserting the ball lock pins.
- b. Move shipping container into position and remove cover.
- c. Remove bolts from container support ring and lower shield assembly to mate with the ring.
- d. Secure shield assembly to container support ring with bolts provided.
- e. Use overhead crane to remove shield handling sling from shield assembly.
- f. Refill or replace desiccant in shipping container.
- g. Secure cover on shipping container and move to storage area.

7-19. RADIATION SHIELD INSTALLATION. Installation of the radiation shield necessitates repetition of the prerequisites and preparatory operations presented in paragraphs 7-12 through 7-14. Upon completion of these operations, continue with installation of the radiation shield in accordance with the steps presented in subsequent paragraphs.

7-20. Preparation.

7-21. Remove the radiation shield from the shipping container (if stored therein), and install on the NPU as follows:

- a. With the Hydra-Set on overhead crane hook, install the radiation shield handling sling on the Hydra-Set.
- b. Remove cover from shield shipping container.

- c. Using the overhead crane, position the shield handling sling over the open shipping container. Lower the sling into position over the shield, using the Hydra-Set to lower it the last few inches to permit mating sling with the shield assembly.
- d. Secure the shield to the sling with the ball lock pins.
- e. Using Hydra-Set and crane, raise the shield assembly approximately four feet above floor level. Move into position over NPU vertical support stand.
- f. Remove sling lock pins and rotate shield assembly 180 degrees. Reinsert lock pins.
- g. Position shield assembly above the shield holding fixture (dish) and carefully lower the shield into the dish. Align shield vertically.
- h. Remove ball lock pins and remove sling from shield assembly trunnions. Using Hydra-Set and crane, lift the sling clear of the shield assembly.
- i. Remove shield sling from the Hydra-Set. Install NPU vertical lifting sling on Hydra-Set.

7-22. Installation. Mate the radiation shield to the NPU as follows:

- a. Position vertical lifting sling over the NPU. Lower the sling to permit attachment to the NPU handling fixture and complete attachment operations.
- b. Lift NPU and move into position over vertical support stand. Carefully lower the NPU onto the vertical support stand, over the radiation shield assembly.
- c. Secure the handling fixture to the support stand.
- d. Operate dolly-mounted hand operated hydraulic pump to raise the shield into position in the NPU.
- e. Align mounting holes of NPU structure shield support ring with NPU attaching nut plates.
- f. Install bolts with the extension wrench and torque to required values.
- g. Retract hydraulic ram to lowest position by slowly releasing hydraulic pressure on hand pump.
- h. Carefully remove shield holding fixture from top of ram.
- i. Disconnect the four turnbuckles from ram end only the turnbuckle brace assembly remains on vertical support stand.

j. Remove ram from inside vertical support stand and move to storage area.

k. Remove vertical lifting sling from handling fixture. Move crane and sling to storage area.

7-23. REFLECTOR ASSEMBLY REMOVAL.

7-24. The following procedure outlines the steps required to remove the reflector assembly and install the shipping sleeve in the event these operations must be performed after the reflector assembly is installed.

7-25. NPU STATUS. Prior to initiating this operation, the NPU shall be installed on the vertical support stand, the NPU work stand placed in position, and the controlled access barriers erected. Void filler blocks and related mechanical safeguards and key-locks shall be in place.

7-26. EQUIPMENT REQUIREMENTS. The following special equipment is required:

- a. Reflector assembly installation fixture and sling.
- b. Reflector assembly handling fixture and sling.
- c. Ejection spring compression fixture.
- d. Special clamps to hold reflector halves while removing retainer band.
- e. Transfer locks and keys.
- f. Special tools required for reflector installation and removal.

7-27. PRECAUTIONS. The following safeguards and precautionary measures shall be observed.

- a. No more than one-half of the fueled core shall be bare at one time.
- b. Drums shall be locked out and keys in possession of the Test Conductor or his designee.
- c. Care shall be exercised to prevent damage to the NPU caused by bumping, dropping, or collision with damaging objects.
- d. White clean gloves shall be worn during this operation.
- e. Drop protector shall be placed under reflector hinge pins before removing, or installing pins.
- f. Drop protector shall be installed for removing retaining band.

7-28. PREPARATION FOR REFLECTOR REMOVAL. The following procedures shall be followed preparatory to reflector removal and sleeve installation operations.

NOTE

Health and Safety Department shall establish radiation level prior to start of this operation.

- a. Ensure void filler blocks are in place.
- b. Remove safety wire from the +Y reflector restraining cable assembly.

NOTE

Accountability of all safety wiring removed shall be verified.

- c. Remove the reflector restraining cable assembly from the reactor vessel external reflector stops and install the special reflector retaining clamp.
- d. Repeat steps b and c for the -Y axis.
- e. Install clamp tool over the electrically activated band release device (EABRD) onto end of bands.

WARNING

Wear safety glasses when removing restraining band to provide eye protection in case of accidental release.

- f. Install "Tee" spacers in both springs.
- g. Loosen bolt holding long band to EABRD using proper wrenches. Adjust clamp tool so that tension in band is taken up enough to allow removal of bolt.
- h. Adjust clamp to relieve tension in band sufficiently to permit removal of graphite foils from under band at support brackets (4) and standoff locations (3).
- i. Secure ends of band to reflector with plastic tie-wrap.
- j. Adjust clamp to relieve all tension and remove band.
- k. Remove bolt holding short band to EABRD, using proper wrenches.
- l. Cut plastic tie-wrap.
- m. Remove bolt holding band to the temperature-activated band release device (TABRD) and remove band.

n. Install void filler block Nos. +3 and +6 in accordance with established procedures.

o. Install shipping sleeve halves on reflector installation fixture. Ensure that shipping sleeve halves face out from center of installation fixture. If they do not, rotate turret rotation crank (blue color code) until they are 180 degrees out from inside center position.

p. Ensure that reflector installation fixture carriages are at the full out position away from center of fixture by manipulating the carriage drive (white) handles.

q. Attach the Hydra-Set to the overhead crane. Attach reflector assembly installation fixture sling to Hydra-Set. Connect sling to installation fixture with the four safety hooks provided.

r. Using the Hydra-Set for the first few inches of travel, raise reflector installation fixture and attach to handling fixture making certain the axis are properly oriented.

s. Install the ejection spring compressor if the springs are installed on the SNAP Unit.

7-29. SLEEVE INSTALLATION AND REFLECTOR REMOVAL. The following procedures shall be followed for installation of the shipping sleeve and for reflector removal.

a. Obtain key for carriage "B" of reflector installation fixture from transfer lock from Mechanical Engineer, and unlock carriage "B" drive. The man in charge of operations shall retain possession of the transfer lock.

b. Move carriage "B" into position for attaching to reflector assembly half by rotating crank (white color code) on the end of the reflector installation fixture.

c. Align and install the ball lock pins to connect the reflector to the reflector installation fixture by adjusting the vertical positioning crank (red color code) and the horizontal positioning crank (white color code).

NOTE

It may be necessary to use the two tilt adjustment screws.

d. Place preload on the reflector half by rotating the vertical positioning crank (red color coded) counterclockwise.

e. Repeat steps a through d on the +Z side of the reflector installation fixture.

- f. Remove the two special clamps on the reactor vessel external reflector stop.
- g. Remove the four reflector assembly lower hinge pins.
- h. Move carriage "A" with reflector assembly half attached, back from the core vessel by rotating carriage "A" drive wheel (white color code) to a point where it is possible to rotate carriage "A" turret. Rotate carriage "A" turret so that reflector assembly faces 180 degrees from core vessel by turning turret rotation wheel (blue color code).

CAUTION

Raise reflector half to maximum adjustment by rotating vertical positioning adjustment counterclockwise to ensure that reflector assembly half hardware (microswitches, cables, etc.) will clear reflector installation fixture before rotating turret.

- i. If ejection springs are installed, remove ejection springs and cups by releasing the two ejection spring compression fixtures for reflector half removed.
- j. Move shipping sleeve half into position around the core vessel by rotating carriage "A" drive wheel (white color code) and adjusting its vertical position with the vertical positioning crank (yellow color code).
- k. Lock carriage "A" by removing key from lock, and return key to transfer lock.
- l. Obtain carriage "B" key from transfer lock, and unlock carriage "B" drive.
- m. Repeat steps h through k for carriage "B".
- n. Lock shipping sleeve halves by rotating the attached swivel bolts into place. Tighten bolts securely.
- o. The ATC in charge of the operation shall inspect the shipping sleeve installation and ensure that it is properly secured around the core vessel.
- p. Remove attach pins from shipping sleeve halves which connect them to carriage "B".
- q. Move carriage "B" back from shipping sleeve, to end of its travel on installation fixture by rotating carriage "B" drive wheel (white color code).
- r. Lock carriage "B" by removing key, and place key back in transfer lock.

- s. Obtain key for carriage "A" from the transfer lock and unlock carriage "A".
- t. Repeat steps p, q and r for carriage "A".
- u. Reinstall the reflector installation fixture guide pins.
- v. Reposition the reflector installation sling over the reflector installation fixture and attach the sling. Lift the reflector installation fixture the first few inches with the Hydra-set and then use the overhead crane to remove the reflector installation fixture assembly to its storage area.

7-30. CENTER OF GRAVITY DETERMINATION.

7-31. The center of gravity (CG) determination is made during final phases of acceptance testing performed at Santa Susana (Building 019). Resultant CG data is forwarded to LMSC for incorporation into their prelaunch data. However, equipment is available at the SPTF to provide the capability for CG determination if this operation should become necessary.

7-32. CG DETERMINATION PROCEDURE. Refer to NAA-SR-MEMO 9356, AGE Operations and Maintenance-Mechanical, for detailed procedures relating to CG determination.

7-33. NaK DOWNLOADING.

7-34. NaK draining equipment is available at the SPTF in the event it becomes necessary to drain the NPU system. Draining equipment is described, with instructions for use, in NAA-SR-MEMO 9356.

7-35. DRAINING PROCEDURE. To drain the NPU system of NaK, perform the following steps using the AGE NaK draining equipment.

NOTE

Provide MET-L-X extinguishers for fighting a NaK fire, notify fire fighting department at VAFB and alert the SPTF handling personnel. Ensure that handling personnel are wearing required protective clothing.

b. If the NaK system is leaking, provide a pan containing dry calcium carbonate for catching any NaK dripping from the NPU.

c. Provide a stainless steel container with several inches of white mineral oil into which NaK may be drained if the AGE container is unavailable.

d. Using dry ice, freeze a portion of the NPU-NaK drain line and a portion of the fill line. Cut each of the lines to provide attachment of Tygon tubing.

e. Connect the AGE reservoir tank to the NPU-NaK drain line, or attach a Tygon tubing to the line and place the open end of the tubing in the catch basin prepared in step c.

f. Actuate vacuum pump on NaK draining equipment after allowing the frozen portion of the NaK line to thaw.

g. Upon completion of draining operations, purge the NaK system with Argon gas, as follows:

1. Shut off vacuum pump, but leave reservoir tank connected to NaK drain line.
2. Attach Argon gas source to NaK fill line.
3. Slowly open the Argon gas source regulator to bleed gas into the NaK system.

CAUTION

Do not permit gas pressure to exceed 10 psi, to prevent possible damage to the NaK system or harm to attendant personnel.

4. Allow gas purge to continue for approximately 5 minutes.
 5. Close Argon bottle regulator upon completion of purge.
- h. Clamp off both Tygon drain and fill lines.
- i. Proceed to package the NPU for return to AI Santa Susana facilities, per NAA-SR-MEMO 9351.

7-36. THERMAL EMITTANCE MEASUREMENTS.

7-37. GENERAL. A thermal emittance measurement may be performed to obtain data for comparison with that taken during the acceptance testing.

7-38. EQUIPMENT REQUIRED. An emissometer is utilized to permit rapid emittance measurements of an opaque surface at room temperature. The Emissometer is a precision laboratory device consisting of a radiometer connected with a flexible conduit to a caster-mounted cabinet. The cabinet contains the electronic readout equipment and power supply. The detector has an output proportional to the infrared emittance when a room temperature surface covers the radiometer opening. Detector output is indicated on the self-balancing potentiometer in the cabinet.

7-39. ENVIRONMENTAL CONDITIONS. Measurements are made at existing atmospheric conditions at the SPTF. Relative humidity should not exceed 70 percent. Room pressure and temperature should be within the range of those recognized as normally acceptable for standard work conditions.

NOTE

Allowances must be made in measurements taken if atmospheric conditions deviate from standard pressures and temperatures of $75 \pm 10^{\circ}\text{F}$.

7-40. SAFETY PRECAUTIONS. White gloves shall be worn by personnel taking emittance measurements. As the work is being performed in a radiological-beryllium posted area, safety precautions relating to entering and working in such an area are applicable (NAA-SR-MEMO-9353).

CAUTION

Smoking, eating, and drinking is prohibited in controlled access areas.

7-41. EMISSOMETER PREPARATION PROCEDURE. The Emissometer shall be prepared for the thermal emittance measurements as follows:

- a. Unlatch the rear door of the Emissometer and connect the power cable to 115 vac.

- b. Observe the water level in the sight glass at the bottom of the cabinet.

NOTE

The water level should be 4 to 6 inches from the bottom of the sight glass when the steam generator is cold.

- c. Add distilled water until the proper level is obtained in the sight glass.

CAUTION

Add the distilled water only through the vent opening in the cabinet.

- d. Turn on the breaker switch at the bottom rear of the cabinet.
- e. Open the potentiometer door on the front of the cabinet.
- f. Unlatch the meter and swing it out. Rotate meter into position.

NOTE

The amplifier power switch will be visible.

- g. Verify that the amplifier power switch is ON.
- h. Close the potentiometer door.
- i. Verify that the two lights at the bottom of the cabinet front are ON.
- j. Verify that the two ammeters indicate current flow.
- k. Open the drawer.
- l. Remove the radiometer.

NOTE

Leave the door open sufficiently for conduit to pass through.

- m. Pull out the shelf above the drawer.
- n. Place the radiometer on the shelf, with the radiometer opening up.

CAUTION

Use only the handles when moving the radiometer.

- o. Warm up the system for approximately 30 minutes.

NOTE

The radiometer will be ready for use when the 5 amp ammeter indicates zero and a wisp of steam issues from the vent at the top of the cabinet.

CAUTION

Always keep sufficient water in the equipment so that water is visible in the sight glass during operation.

7-42. CALIBRATION. Calibrate the Emissometer as follows:

- a. Turn the potentiometer dial switch (inside the potentiometer door) to ON.
- b. Turn the BIAS switch to ON.
- c. Turn the selection switch to position V_R .
- d. Cover the radiometer opening with the zero emittance reference (stored in the cabinet) (polished metal at 100C).
- e. Adjust the ZERO control on the cabinet to indicate ZERO on the potentiometer.
- f. Remove the zero emittance reference and note the room temperature.

NOTE

Use the thermometer mounted on the cabinet.

- g. Using Figure 7-1 for reference, locate the intersection of the line $\epsilon = 0.90$ and the ambient room temperature.
- h. At the point of intersection read down vertically to determine the value for radiometer output V_R .
- i. Place the insulation standoff on the cover of the radiometer and snap into position.
- j. Cover the opening in the standoff with the stannic oxide standard.
- k. Adjust the attenuator knob so that the potentiometer reads V_R (refer to step h).
- l. Cover the radiometer with the zero emittance reference (polished metal at 100C).

- m. Adjust the ZERO control on the cabinet to indicate ZERO on the potentiometer.
- n. Remove the zero emittance reference and note the room temperature.

NOTE

Use the thermometer mounted on the cabinet.

- o. Place the insulation standoff on the cover of the radiometer and snap into position.
- p. Cover the opening in the standoff with the stannic oxide standard.
- q. Adjust the attenuator knob so that the potentiometer reads V_R .

7-43. MEASUREMENT PROCEDURE. Four distinct measurements shall be taken for each surface monitored. The average of the four measurements are recorded in Data Sheet provided in the related section the NPU Verification Log. Proceed to take the measurements as follows:

- a. Grasp the detection head by its carrying handle.
- b. Place the viewing port against the thermal control surface being measured.
- c. Read the radiometer output on the potentiometer scale and record on related NPU log Data Sheet.
- d. After the measurement is recorded, refer to the graphs in Figure 4-3 and determine the intersection of the line V_R and the sample temperature.
- e. Read the point of intersection horizontally to the ordinate. This is the thermal emittance value.

NOTE

Use either graph in Figure 7-1, as applicable.

- f. Record the emittance value on the data sheet. (A sample data sheet is shown in Figure 7-2.)

Figure 7-1. Measurement Points for Thermal Emittance and Solar Absorptance Measurements

SNAPSHOT

NPU VERIFICATION LOG DATA SHEET NO. _____

Prelaunch Operation: Thermal Emittance Measurement

Sheet _____ of _____

Reference: NPU Prelaunch Ops.-SPTF, Sec. 5, Par. 5-85

Site _____

Test Equipment Req'd: Emissometer, Model No. M-2

Date_____

[illegible]

Technician _____ Date _____

QC Representative _____ Date _____

Test Conductor _____ Date _____

Figure 7-2. Data Sheet Used for Recording Heat Shield Coating Data

7-44. Return the Emissometer to the Instrument Laboratory upon completion of the test.

CAUTION

The Emissometer shall be placed in its special handling case before being moved.

7-45. SOLAR ABSORPTANCE MEASUREMENTS.

7-46. GENERAL. Solar absorptance measurements of the power converter radiative surfaces are made to obtain data for comparison with that taken during the acceptance testing phase. Comparison of the data provides a means of detecting possible deterioration or changes in the reflective coatings.

7-47. EQUIPMENT REQUIRED. Measurements are performed using a Model SRM-2 Reflectometer. This is a precision laboratory instrument, a mobile solar reflectometer which has been modified for field use. It is capable of measuring the reflectance of a surface for solar energy absorption above the atmosphere of the earth.

7-48. The reflectometer consists of a detection head and a portable cabinet with electronic power supply and readout systems. In the detection head, radiation from a xenon lamp is filtered and led into an integrating sphere. When the radiation is directed onto a surface placed over the sample port, the detector in the sphere has an output proportional to the amount of reflected radiation. The output is read off the indicating potentiometer in the cabinet.

7-49. ENVIRONMENTAL CONDITIONS. Measurements shall be performed under the same conditions outlined in paragraph 7-39.

7-50. SAFETY PRECAUTIONS. Safety precautions outlined in paragraph 7-40 are applicable to solar absorption measurement procedures.

7-51. PREPARATION REQUIREMENTS.

7-52. The reflectometer shall be prepared for operation as follows:

- a. Plug the power cable into a 115 vac line.
- b. Unlock the rear door of the cabinet.
- c. Place the breaker switch in ON position.
- d. Lock the rear door of the cabinet.

- e. Open the bottom drawer.
- f. Remove the detection head.

The detection head is a sensitive device; observe care in handling.

- g. Connect the detection head to the cabinet electronics with the cable.
- h. Pull out the sliding shelf.
- i. Set the detection head on the shelf with the lowered case down.
- j. Remove the protective cover from the detection head to expose the sample port in the center of the detection head.

Do not touch the detection head while firing the lamp.
Verify that the detection head blower is operating.

- k. Fire the Xenon lamp by turning the ON/OFF switch to ON.

NOTE

An indication on the LAMP CURRENT meter indicates that the lamp has fired.

- l. Set the CURRENT ADJUST to midrange and verify that the no-load voltage is 30-45 vdc.
- m. Press the lamp START switch.

Avoid bodily contact with the high voltage leads.

- n. Adjust the current so that it is in the range of 5 to 6 amps.
- o. Read the lamp voltage and record voltage.
- p. Adjust the lamp current until the product of the current and the voltage is 75 watts.

7-53. CALIBRATION. Calibrate the reflectometer as follows:

- a. Set the potentiometer dial switch located inside the potentiometer door to ON.
- b. Set the BIAS switch to ON.
- c. Index the filter wheel switch to position S.

NOTE

The filter wheel switch is located on top of the detection head.

- d. Index the 100-5 switch to position 100.

NOTE

The 100-5 switch is located on the side of the detection head.

- e. Adjust the ZERO control to indicate zero on the potentiometer

NOTE

The zero control is located on the potentiometer cabinet.

- f. Index the filter wheel switch to position 0.
- g. Adjust the ATTEN control to indicate 100 on the potentiometer.

NOTE

The ATTEN control is located on the potentiometer cabinet.

7-54. MEASUREMENT PROCEDURE. Make the solar absorptance measurements as follows. For each surface monitored, four distinct measurements will be performed at the locations on the thermal control surface. The four absorptance measurements will be averaged and recorded in the data sheet.

- a. Grasp the detection head firmly.
- b. Place the viewing port against the thermal control surface to be measured.
- c. Read the solar reflectance (R) on the potentiometer scale, and record on the data sheet.

d. Return the reflectometer to the Instrument Laboratory after completing the measurements.

Place the reflectometer in the special handling case before moving.

SECTION VIII

INTERIM OPERATIONS

8-1. GENERAL.

8-2. This phase of operations pertains to routine inspections and checks which are performed after the NPU is returned from the launch complex upon completion of the first pad cycle.

8-3. SCOPE AND PURPOSE. Operations performed during this period are for the purpose of verifying flight readiness condition of the NPU. The activities include a repetition of fundamental electrical checks and final prelaunch delivery preparations. These include the following:

- a. Power converter resistance and continuity checks.
- b. Unpowered relay status check.
- c. Thermal emittance measurements.
- d. Reflector assembly inspection.
- e. Physical inspection of NPU system.

8-4. SCHEDULING. Interim operations shall be scheduled by the Test Conductor as expedient with unscheduled or unanticipated operations which may be required as a result of the first cycle pad operations. Procedures included in this section reflect operations which shall be completed during the interim period. Under optimum conditions, the operations may be performed in the sequence in which they are presented, or at the discretion of the Test Conductor, be rescheduled in accordance with other activities to be completed in the interim period.

8-5. NPU UNPACKAGING. Upon return to the SPTF, unpackage the NPU in accordance with procedures presented in Section IV, paragraphs 4-9 through 4-18.

8-6. HEAT SHIELD UNPACKAGING. The need to unpackage the heat shields shall be determined by the Test Conductor. In the event the heat shields are unpackaged and inspected in accordance with procedures presented in Section IV, paragraph 4-20.

8-7. NPU POWER CONVERTER RESISTANCE AND CONTINUITY CHECKS. Check power converter resistance and continuity in accordance with procedures presented in Section IV, paragraphs 4-65 through 4-76.

8-8. THERMAL EMITTANCE MEASUREMENTS. Complete the thermal emittance measurements in accordance with procedures presented in Section IV, paragraphs 4-46 through 4-54.

8-9. REFLECTOR ASSEMBLY INSPECTION.

8-10. PURPOSE AND SCOPE. The purpose of interim inspection of the NPU reflector assembly is to verify flight readiness condition following completion of the first cycle of launch pad operations. The inspection includes measurement of critical clearances and preparation for functional checks.

NOTE

Scheduling of this operation is at the discretion of the Test Conductor as determined by other operations that may be performed during this period.

8-11. NPU STATUS. The inspection is performed after the NPU has been unpackaged and installed on either the guide fixture or the vertical support stand.

NOTE

Mounting of the NPU for checkout is dependent upon other operations that are to be performed during the interim period.

8-12. VESSEL-REFLECTOR CLEARANCE CHECK. Check reactor vessel and reflector clearances as follows:

a. Measure and record the clearances between the fixed hinges and the vessel bushings. Terminology is based on the observer facing the hinges.

b. Measure and record minimum clearances between the floating hinges and vessel brackets. Terminology is based on observer facing the hinges. The position of minimum clearances is also to be determined approximately.

c. Measure and record clearances between hex head adjusting bolts and bracket at top of reflector. Terminology based on observer facing and looking down at reactor at Y stations.

d. Measure and record clearances between dome head adjusting pin and reflector bracket. Terminology is based on observer facing and looking down at reactor at Y stations.

NOTE

The following operation must be completed prior to initiating the functional checks. Due to other operations that may be in process, the preparation operations will be scheduled as required.

8-13. Prepare the reflector for functional checkout as follows:

- a. If antivibration latches on fine control drums have not been raised, raise and torque nuts tight enough to hold in place.
- b. Check actuators for band status switches.
- c. Check gear-pinion engagement. (A light and mirror may be needed, area must be clear and engagement free.)

8-14. UNPOWERED RELAY STATUS CHECK. Perform the unpowered relay status check in accordance with procedures presented in Section IV, paragraphs 4-77 through 4-81.

8-15. ELECTRICAL SYSTEM FUNCTIONAL CHECKS. Performance of the NPU system functional checks shall be at the discretion of the Test Conductor. This check shall be performed in accordance with the procedures presented in Section IV, paragraphs 4-96 through 4-110.

NOTE

The Test Conductor and Engineering Supervisor shall determine whether the scope of this check, and at their discretion, may elect to perform only specific portions of the check.

8-16. NPU PREPACKAGING INSPECTION.

8-17. PURPOSE AND SCOPE. The purpose of this inspection is to verify flight readiness of the NPU system upon completion of interim period operations. The inspection includes thorough visual examination of accessible portions of the NPU. In addition, the reflector assembly is inspected and predelivery operations completed.

8-18. NPU VISUAL INSPECTION. Inspect the NPU system in accordance with procedures presented in Section IV, paragraphs 4-21 through 4-28.

8-19. REFLECTOR ASSEMBLY INSPECTION. Inspection and preparation of the reflector assembly prior to packaging the NPU for final delivery to the launch complex shall be performed as follows:

- a. Verify satisfactory status of reflector assembly as follows:
 1. Examine interior of snap-in springs and top bearing for dirt and debris. Vacuum if necessary.
 2. Examine drum surfaces and top of main block; clean if necessary.
 3. Check exposed Be reflector surfaces for evidence of fingerprints; remove visible fingerprints with clean rag dampened with alcohol.
- b. Examine gear and pinion teeth and pinion pin.
- c. Check bottom bearings for dirt and vacuum if needed.
- d. Check pin status of band stand offs.
- e. Examine all keylocks; keylocks should be installed (barrels ON), bolt engaged with drum latch bracket and keys removed (LOCKED).
- f. Examine all pin pullers for shear wire integrity; collet lockwire. Verify that dummy squibs are inserted and that connectors are snug and tight but not lockwired.
- g. Verify that installation of flight hinge pins is satisfactory and that they are keyed in place.
- h. Verify that installation of flight eccentric pins is satisfactory and the pins are pinned and held in place with snap ring.
- i. Verify satisfactory installation of ejection springs.
- j. Verify installation of the EABRD in the band and that connection of the EABRD leads to the isolation strip is satisfactory.
- k. Inspect top of the vessel for dirt and vacuumed if necessary.
 1. Verify the integrity and installation of the gold foil and tantalum cover and remove all fingerprints. Examine the space between the two bandlugs, and the space between the bottom of the lower band lug and the actuator top to insure that the graphite foil is in place and that the nut is down on the lugs.
- m. Inspect all lockwire and tab washers on the drum actuator (stepper motor).

n. Inspect lockwire on the band status switch bracket and the snap-in spring installation lockwire. The two thermocouples are also to be checked for lockwiring integrity.

o. Inspect all locking devices on the position sensors including couplings and yokes.

p. Inspect all Be shim plates as to number and lockwiring.

q. Inspect all four latch brackets for satisfactory attaching bolt lockwire. The position of, and torque on the nuts of the antivibration latches are also to be checked (fine control drums only).

NOTE

The interlock bar must be disengaged from the keylock bolt (course control drums only). This is assured if the bar is straight and is held down against the spring force by the pin puller.

r. Verify wiring harness mounting integrity. Each side of the wiring harness has two bolts holding U brackets in place below the pin pullers which are lockwired. Also, each side has 12 bands holding the harness in place on the brackets. These all must be checked.

s. Inspect lockwire on the hinge bracket bolts.

t. Inspect lockwire on all four lower bearing retainer plates.

u. Inspect miscellaneous electrical components as follows:

1. Check drum limit switches for cracked or chipped cases or shorted lugs.
2. Check band status switches for case damage and actuator spring engagement.
3. Check reflector eject switches for case damage and mounting integrity.
4. Verify integrity of lockwiring, cable clamping and weld integrity of applicable interface connectors.

8-20. NPU PACKAGING.

8-21. Package the NPU for delivery to the launch complex per procedures presented in NAA-SR-MEMO 9351, SNAP 10A Shipping Procedures, Volume II.

NAA-SR-MEMO-9352

SECTION IX
NPU PRELAUNCH OPERATIONS - SUPPORT PARTS

9-1. GENERAL.

9-2. This section provides definition of the spare parts and materials necessary for Maintenance/Repair support of the SNAP 10A Flight System Test Program at Vandenberg Air Force Base. For detailed requirements of SPTF stocked support parts (NPU and AGE) refer to SNAP 10A VAFB Spares Provisioning List, Dwg. 10FS-00005. The referenced list is comprised of seven sections, each consisting of like-item category groupings as follows:

a. Section I - Bulk List. Items generally considered to be raw (bulk) stock such as shims, cement, tape, tubing, sleeving, grease, electrical wire, etc. Bulk parts are identified by dimensional characteristics, trade-name, part number, and vendor as applicable. Items are arranged by noun-name in alphabetical sequence. Quantities are usually procured by ounce, quart, inch, or feet measurement, rather than unit each. Shelf life is given for items of deteriorable nature.

b. Section II - AI Parts. Items of AI manufacture (Prime Contractor) identified by nomenclature and part number. Provisionable spares may be an entire assembly or relatively minor items such as clamps. Items are arranged by AI drawing number sequence.

c. Section III - Standard Parts. Common hardware items provisionable as spares conforming to Government or Company Standard Specifications, i. e. , AN, LD, MS, NAS, ND. Listing is arranged in noun-name alphabetical sequence from Bolt to Washer. Within any given noun-name grouping of common items (Ex: Clamps) part numbers are arranged in numerical sequence.

d. Section IV - Commercial Parts. Hardware items normally procurable from commercial vendor sources not identifiable within Government Standard Specifications. Listing arrangement is by noun-name in alphabetical sequence. Noun-name groupings (Ex: Clamps) are further arranged in manufacturer's part number numerical sequence. The manufacturer's name is also listed. Where a part number has not been assigned (Ex: Screw) the item is listed by noun-name and identified by dimensions, material, etc. to facilitate replacement procurement from commercial sources.

e. Section V – Equipment Specs and Spec Control (Hi Value). Major items of electrical components source controlled by Atomics International (Design Activity) due to special fit, reliability of performance, or other peculiarities of the SNAP 10A system. Items proper will be identified, as applicable, with the vendor supplier manufacturer's part number and the AI Spec. Control number. Listing arrangement is numerically by AI Spec Control part number with the manufacturer's name in parenthesis.

f. Section VI – Electrical Connectors. Government Standard and commercial vendor procured electrical connectors for the NPU system wiring harnesses and black boxes are listed in this section. All items are identified by the common noun-name: CONNECTOR. Assigned Reference Designations J and P are listed to further identify items within the electrical systems. Listing arrangement is in part number numerical sequence with the commercial parts vendor source identified in parenthesis.

g. Section VII – GSE Electronics. Government Standard, Atomics International, and commercial source procured electrical components and hardware items for SNAP 10A Ground Support Equipment are herein defined. Listing arrangement is by noun-name in alphabetical sequence. Vendor sources are identified in parenthesis in the part number column. Additional identifying data is listed in the Reference Symbol Number column.

9-3. The SMR CODE and USABLE ON CODE columns of Spares Provisioning List 10FS-0005 have no significance for SPTF personnel.

9-4. ILLUSTRATED PARTS BREAKDOWN. Major replacement components of the SNAP 10A system are listed in an order of disassembly sequence keyed to an assembled illustration view of the NPU to serve as a visual index to the parts breakdown. Refer to figure 9-1.

9-5. Indention to Show Relationship.

9-6. Items are arranged in an indenture system to permit determination of the next higher assembly to which a part pertains or, also, the details which comprise an assembly. The main assembly (NPU Final Assembly) is listed first without indention (Column 1 item). Component parts and/or subassemblies to Column 1 are listed with the indention of one space (Column 2 item). Component parts and/or sub-subassemblies are listed after Column 2 with the indention of two spaces (Column 3 item). This sequence of indention is continued to the extent necessary to portray details of the SNAP 10A NPU.

9-7. Description Column.

9-8. This column contains the basic item name of each part followed by an identifying description as required. Additional parenthetical information is provided as deemed necessary such as: location (Bay A), vendor (G. E.), Reference Designations (P800S), and quantity "used on" per next higher assembly (One ea. used on 10FS-22006-1 and -2).

9-9. Index Numbers.

9-10. Index numbers are assigned to major parts having maintenance or supply significance and are transposed to the corresponding illustration for ease of identification and location within the system.

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1 2 3 4 5 6 7		
		Note - This Illustrated Parts Breakdown includes only major items of procured spares. For a complete support parts accounting refer to VAFB Spares Provisioning List, Dwg. 10FS-00005.		
		SNAP 10A SYSTEM - NPU		
1-	10FS-60005 10FS-11001	NPU FINAL ASSEMBLY	1	
		REFLECTOR ASSEMBLY AND INSTALLATION	1	
-1	10FSM1-11130-3	FUSIBLE LINK ASSEMBLY	1	
-2	10FSM1-11130-4 10FS-22033	FUSIBLE LINK ASSEMBLY	1	
		WIRING AND T/C INSTALLATION, Reflector Assembly	1	
-3	10FS-11052	ACTUATOR ASSEMBLY, Electrically Actuated Band Release Device (EABRD)	1	
	10FS-11003-3	REFLECTOR ASSEMBLY	1	
	10FS-11003-4	REFLECTOR ASSEMBLY	1	
-4	10FSM1-11061	STEPPER MOTOR ASSEMBLY, Con- trol Drum Actuator(CONFIDENTIAL) (One ea. used on 10FS-11003-3 and -4).	2	
-5	NE10FSM1-16-001	TRANSMITTER, Control Drum Position (One ea. used on 10FS-11003-3 and -4)(PnI-1T, +Z; PnI-2T, -Z).	2	
	10FS-61003	STRUCTURE ASSEMBLY, NPU	1	
	10FSM1-12013	SUPPORT ASSEMBLY, Reactor	1	
	10FSM1-11132	BAND RELEASE DEVICE INSTALLATION, Temperature Actuated (TABRD)	1	
-6	10FSM1-11133	ACTUATOR ASSEMBLY, Temper- ature Actuated Band Release Device	1	
	10FSM1-61042	EJECTABLE HEAT SHIELD INSTALLA- TION	1	
-7	10FS-86009	PIN PULLER ASSEMBLY, Ejectable Heat Shield	2	
	10FS-20001	INSTRUMENT INSTALLATION, NPU	1	
	10FS-21012	INSTRUMENT INSTALLATION, Reactor Inlet Tube, RC and manifold	1	
	10FS-20014	ACCELEROMETER ASSEMBLY	1	
-8	NE10FS-24-011	ACCELEROMETER (Endevco) (AC-1T, X axis; AC-2T, Y axis; AC-3T, Z axis)	3	
	10FS-21011	INSTRUMENT INSTALLATION, Reactor Outlet Area, Y axis	1	
-9	NE10FS-24-005	DETECTOR, Hi Flux Neutron, (G. E.) (ND-1T)(NPU Station 103 to 112)	1	
-10	10FS-20016-3	PLUG ASSEMBLY, Safe (P800S), green cap (For handling use only), Station 2.000	1	
-10	10FS-20016-4	PLUG ASSEMBLY, Arm (P800A), red cap (Remove prior to installation of pyrotechnics), Station 2.000	1	
	10FS-22001	COMPONENT ASSEMBLY, Instrument Compartment	1	
-11	10FS-22002	RELAY BOX ASSEMBLY, Main (Bay A)	1	
	10FS-22006-1	FUSISTOR ASSEMBLY, Left Hand	1	
	10FS-22006-2	FUSISTOR ASSEMBLY, Right Hand	1	
	10FS-22015	CHASSIS ASSEMBLY, FUSISTOR, Relay Box (One ea. used on 10FS-22006-1 and -2)	2	

Table 9-1. Illustrated Parts Reference, Page 1 of 2

FIG. & INDEX NO.	PART NO.	DESCRIPTION							UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5	6	7		
		SNAP 10A SYSTEM - NPU (CONT)								
1-12	10FS-24007	.	.	.	.	FUSISTOR (Spec. Cont. Dwg.)				
						(F1 through F8 used on				
						10FS-22006-1 and F9 through				
						F16 used on 10FS-22006-2)				
						(Bradford Co.)			16	
-13	10FS-22023	.	.	RELAY BOX ASSEMBLY, Degradation						
				(Bay H)					1	
-14	NE10FS-24-009	.	.	BRIDGE ASSEMBLY, Multi-channel,						
				Resistance type temperature detector						
				(For RT-1 through RT-6 and RT-9						
				through RT-18)(Winsco)(Bay H)					1	
-15	10FS-24011	.	.	SHUNT, Instrument, 50MV (Spec. Cont.						
				Dwg.)(IT-1, IT-2, IT-3)(Janco)						
				(Bay H, B)					3	
-16	NE10FS-24-013	.	.	MEASURING DEVICE, Converter						
				Degradation, (CZ), (Bay H)					1	
-17	10FS-20011	.	.	VOLTAGE DIVIDER ASSEMBLY						
				(VT-1, VT-2), (Bay H)					1	
-18	NE10FSM1-20-004	.	.	CONTROLLER, Startup (Bendix)						
				(C1-1)(Bay G)					1	
-19	NE10FS-24-003	.	.	DETECTOR, Gamma Radiation (G. E.),						
				(RD-1T), (Bay F)					1	
-20	NE10FS-24-006	.	.	POWER SUPPLY, Gamma Detector,						
				(G. E.), (RD-1A/1P), (Bay F)					1	
-21	NE10FS-24-002	.	.	POWER SUPPLY, Hi Flux Detector.						
				(G. E.), (ND-1P), (Bay F)					1	
-22	NE10FS-24-004	.	.	DETECTOR, Low Flux Neutron,						
				(G. E.), (ND-3T)(Bay E)					1	
-23	NE10FS-24-011	.	.	ACCELEROMETER (Endevco), (AC-1,						
				X direction; AC-2, Y direction;						
				AC-3, Z direction), (Bay E)					3	
-24	NE10FS-24-001	.	.	POWER SUPPLY, Low Flux Detector,						
				(G. E.), (ND-3A/3P), (Bay D)					1	
-25	NE10FS-24-008	.	.	DEMOMULATOR, Expansion Compens-						
				ator Position, (Vinson), (PnI-4,						
				PnI-5), (Bay D)					2	
-26	NE10FS1-24-010	.	.	DEMOMULATOR, Control Drum						
				Position Indicator, (Walkirt), (PnI-1,						
				PnI-2), (Refer to 10FS-20018),						
				(Bay C)					2	
-27	10FS-22032	.	.	TRANSFORMER, Converter Degradation						
				(Abbott Labs), (Bay C)					1	
-28	NE10FS1-24-012	.	.	TIMER, Reflector Ejection Delay						
				(1 min. -1hour), (ELD/ESD), (Bay B)					1	
-29	10FS-20012	.	.	TRIP DEVICE ASSEMBLY (contains						
				two NE10FS-20-010, SW-5A and						
				SW-5B)(Bay B)					1	
-30	10FS-22017	.	.	RELAY BOX ASSEMBLY, Auxiliary						
				(Bay B)					1	
	10FS-14001	.	.	HEAT BARRIER INSTALLATION,						
				Instrument Compartment					1	
-31	10FS-14003	.	.	DOOR, HEAT BARRIER, Instrument						
				Compartment					1	
	LMSC	.	.	AGENA VEHICLE					REF	
	10FS-22029	.	.	BATTERY AND CASE OUTLINE, NaK						
				Pump Primary (Spec. Cont. Dwg.)						
				(AI procured; LMSC mounted AGENA						
				Forward Auxiliary Rack)					2	
-32	NE10FSM1-24-008	.	.	BATTERY, PRIMARY, NaK Pump						
				(AI procured; LMSC mounted						
				AGENA Forward Auxiliary Rack)					2	

Table 9-1. Illustrated Parts Reference, Page 2 of 2

12-16-64

7561-02178

Figure 9-1. Page 1 of 2

Issued 19 February 1965

9-6

12-16-64

7561-02178-1

Figure 9-1. Page 2 of 2

Issued 19 February 1965

9-7

ADDENDUM A
FULL CURRENT SQUIB FIRE TEST

This squib fire test is performed to verify the integrity of the squib firing circuitry, especially the current carrying capability of the circuit wire.

Figure A-1 shows the test setup. The test is conducted in seven segments as follows:

Pretest Verification/Preparation

- a. Verify satisfactory completion of Electrical Reference Test-Unpowered No. 2.
- b. Verify all relays are in prelaunch status per previous unpowered relay status check.
- c. Verify no power on NPU busses.
- d. Verify SAFE plug installed.

NOTE

Subsequent preparatory operations are verified and recorded on Data Sheet No. 4-4.

Tooling Squib Installation/Verification

- a. Disconnect each simulated squib from its pin puller assembly.

NOTE

Where required, remove pin puller support blocks and wiring on brackets.

- b. Measure/record bridgewire resistance of each, using IGNITER CIRCUIT TESTER (ICT).
- c. Measure/record bridgewire insulation resistance of each, using modified VON.

Revision A

NAA-SR-MEMO-9352

Figure A-1. Simulated Squib Fire Diagram

SNAPSHOT

NPU VERIFICATION LOG DATA SHEET NO.

Prelaunch Operation: PREFIRE SQUIB STATUS

Reference: _____

Test Equipment Req'd: _____

Sheet 1 of 1

Site SPTF

Date _____

1	2	3	4	5	6	7	8	9	10
SQUIB CIRCUIT DESC.		Verify Sim. Squib Removal	Bridgewire Resistance 0.65±0.1	Bridgewire Insulation reg.	Squib Ckt. Loop Res. 5.0±0.4	Squib Ckt. Volts 0±0.1 v	V E R I F I C A T I O N		
							Tooling	Debris	Safe Plug
							Squib Con.	Catcher In.	No-fire
S1	P801 CCD #1								
S2	P802 CCD #1								
S3	P803 CCD #2								
S4	P804 CCD #2								
S5	P805 FCD #1								
S6	P806 FCD #1								
S7	P807 FCD #2								
S8	P808 FCD #2								
S9	P809 EC #1								
S10	P810 EC #1								
S11	P811 HS #1								
S12	P812 HS #2								
S15	P815 EC #2								
S16	P816 EC #2								

Technician _____ Date _____

QC Representative _____ Date _____

Test Conductor _____ Date _____

- d. Measure/record circuit pin-to-pin loop resistance of firing circuit using ICT.
- e. Measure/record voltage across the firing circuit leads, using VON.
- f. Verify results acceptable.
- g. Connect the tooling squibs to the connectors.
- h. Verify that debris catchers are installed around each squib.
- i. Install breakout boxes to following connectors: J102____, J103____, J104____, J601____, J602____.
- j. Connect test set cables to above; short-couple squib power to J103.
- k. Close all switches to breakout boxes EXCEPT for the following: J103A____, J104f____, J602-1____, J102X____, J104e____, JJ601-18____, J102W____, J103B____.

Test Equipment Setup

- a. Set up Tektronix oscilloscope, Model 545A, as follows:
 - 1. Set the sweep to SINGLE SWEEP.
 - 2. Connect jumper wire from + GATE A terminal to + TRIGGER INPUT terminal of Tektronix Type 112 Waveform Generator.
- b. Connect waveform generator GATE OUTPUT to coil of a Potter Brumfield Relay, Type SC11D. Set pulse interval of generator to 5 milliseconds.
- c. Connect one set of relay contacts as follows:
 - 1. Wiper to breakout box J103A (test set side).
 - 2. Normally open contact to J103-A, NPU side.
- d. Connect a 50 amp/50 mv shunt as follows:
 - 1. Jumper one terminal of the current shunt to J103-B (NPU side).
 - 2. Jumper the remaining terminal of the shunt to test set side of J103-B.
- e. Install an MTH-4 fuse in test set squib bus fuse holder.
- f. Connect millivolt output of current shunt to scope VERTICAL INPUT.
- g. Install jumper across J104-e to f, NPU side only.
- h. Connect the remaining set of relay contacts as follows:

1. Wiper to breakout box J102-A, test set side.
2. Normally open contact to breakout box J104-e or f.
- i. Activate the following busses, using TSM-2A:
 1. Unregulated bus .
 2. Squib bus .
- j. Install ARM plug in P800.
- k. Reset all NPU relays and switches to preflight status, from TSM-2A.
- l. Install J501 cable from TSM-2A.
- m. Enable squib bus (using TSM-2A).
- n. Remove J501 cable from TSM-2A.
- o. Replace arm plug with SAFE plug.
- p. Complete following equipment setup:
 1. Tektronix scope: 10 msec/CN sweep, single sweep.
 2. Tektronix scope: VERTICAL INPUT at highest on-scale deflection.
 3. Waveform generator: 100 msec pulse width, triggered.

Safe Fire Protection

NOTE

Perform the following operation while photographing the waveform on the scope.

- a. Depress the RESET button to initiate a single sweep.

NOTE

This will also apply power to the squib bus and power relay necessary to fire applicable squibs.

- b. Verify reflector squibs did not fire by visual examination of the bridgewires; record results in Data Sheet No. 4-5.
- c. Verify that the following startup relays transfer from RESET to OPERATE. K1____, K19____, and K21____.

- d. Move jumper wire from normally open contact of relay from J104e to break-out box J102X, on NPU side only.
- e. Install jumper across breakout box J102 pins X to W, on NPU side only.
- f. Verify Tektronix scope status:
 - 10 msec/CM sweep, single sweep.
 - VERTICAL INPUT at highest on-scale deflection.
- g. Verify waveform generator at 100 msec pulse.

Safe Fire Protection, Expansion Compensator Squibs

NOTE

Perform the following operation while photographing the waveform on the scope.

- a. Depress the RESET button to initiate a single sweep.

NOTE

This will also apply power to the squib bus and power relays necessary to fire the expansion compensator squibs.

- b. Verify expansion compensator squibs did not fire, by visual examination of the bridgewires; record results in Data Sheet No. 4-5.
- c. Move relay normally open contact jumper wire from breakout box J102-X, to breakout box J601-18, on NPU side.
- d. Install jumper across breakout box J601-18 to breakout box J602-1 on NPU side only.
- e. Verify Tektronix scope status:
 - 10 msec/CM sweep, single sweep.
 - VERTICAL INPUT at highest on-scale deflection.
- f. Verify waveform generator at 100 msec pulse width, triggered.

Safe Fire Protection, Heat Shield Squibs

NOTE

Perform the following operation while photographing the waveform on the oscilloscope.

- a. Depress the RESET button to initiate a single sweep.

NOTE

This will also apply power to the squib bus and power relays necessary to fire the heat shield squibs.

- b. Verify heat shield squibs did not fire, by visual examination of the bridge-wires; record results in Data Sheet No. 4-5.
- c. Verify following relay status: K14 resets, K21_____ and K19_____.
- d. Reset all NPU relays and switches to preflight condition, from TSM-2A.
- e. Install P501 cable from TSM-2A.
- f. Enable NPU squib bus, from TSM-2A.
- g. Remove P501 cable from TSM-2A.
- h. Move relay normally open contact jumper from J601-18, to J104-e, on break-out boxes.
- i. Install ARM plug on NPU.

Final Equipment Setup

- a. Verify Tektronix scope status:
 1. 10 msec/CM sweep, single sweep.
 2. VERTICAL INPUT at highest on-scale deflection.

NOTE

Perform the following operation while photographing the waveform on the scope.

- b. Depress the RESET button to initiate a single sweep.

- c. Move relay normally open contact jumper from J104-e to breakout box J102X on NPU side.
- d. Install jumper across breakout box J102 pins X to W, on NPU side only.
- e. Verify Tektronix scope status:
 - 1. 10 msec/CM sweep, single sweep.
 - 2. VERTICAL INPUT at highest on-scale deflection.
- f. Verify waveform generator at 100 msec pulse width, triggered.

NOTE

Perform the following operation while photographing the waveform on the scope.

- g. Depress the RESET button to initiate a single sweep.
 - 1. Move relay normally open contact jumper from J102-X to breakout box J601-18.
 - 2. Install jumper from J601-18 to J602-1, NPU side only.
 - 3. Verify Tektronix scope status:
 - 10 msec/CM sweep, single sweep.
 - VERTICAL INPUT at highest on-scale deflection.
 - 4. Verify waveform generator at 300 msec pulse width, triggered.

NOTE

Perform the following operation while photographing the waveform on the scope.

- 5. Depress the RESET button to initiate a single sweep.
- h. Install SAFE plug.
- i. Verify following steps have been completed:
 - 1. Visual verification that each squib has fired.
 - 2. Insulation to case resistance measured/recorded for each squib.
 - 3. Verify bridgewire is open using igniter tester.
 - 4. Simulated squib installation and serial number recorded.

SNAPSHOT

NPU VERIFICATION LOG DATA SHEET NO.

Prelaunch Operation: POST-FIRE VERIFICATION, Full Current Squib Fire Demonstration

Sheet 1 of 1

Reference: _____

Site _____

Test Equipment Req'd: _____

Date _____

1	2	3	4	5	6	7	8	9	10
SQUIB CIRCUIT DESC.		Visual Fire Verification	Tool Squib Insulation Resist.	Tool Squib B/W Open Verification	Inst'n and Ident'n - Sim Squib	Sim Squib Insulation Resistance	Sim Squib Bridgewire Resistance	Fusistor Status - Ckt. Res.	Ckt Conn Volts Verif.
S1	P801 CCD #1								
S2	P802 CCD #1								
S3	P803 CCD #2								
S4	P804 CCD #2								
S5	P805 FCD #1								
S6	P806 FCD #1								
S7	P807 FCD #2								
S8	P808 FCD #2								
S9	P809 EC #1								
S10	P810 EC #1								
S11	P811 HS #1								
S12	P812 HS #2								
S15	P815 EC #2								
S16	P816 EC #2								

Technician _____ Date _____

QC Representative _____ Date _____

Test Conductor _____ Date _____